THE
TROPICAL AGRICULTURIST:
JOURNAL OF THE
CEYLON AGRICULTURAL SOCIETY.

VOL. XLII. COLOMBO, APRIL, 1914. **No. 4.**

COTTON.

Peradeniya, April 15, 1914.

During the season 1912-13 fifty small plots in various parts of Ceylon were placed under cotton by the Department of Agriculture and the Agricultural Society, the variety chosen being Allen's Long Staple American Upland. Of these only one plot of $1\frac{3}{4}$ acres at Ambalantota in the district of Hambantota in the south-east part of the island was satisfactory. This plot yielded at the rate of 1,043 lb. of seed cotton per acre.

Planting took place in October 1912, the seeds being sown 20 inches apart in rows 3 feet apart. Flowering took place in the end of December and picking began early in March.

The land was placed at the disposal of the Society by the Assistant Government Agent of Hambantota, the experiment being carried out under the supervision of Mr. N. M. JAYASURIYA, Agricultural Instructor, with the co-operation of AMERASEKERE MUDALIYAR of Magam Pattu.

The crop was ginned in Colombo and two bales of lint sent to Liverpool sold for $7\frac{1}{2}d.$ and $9\frac{1}{2}d.$ per lb., the price of American middling at the same time being $7{\cdot}35d.$ The cotton was grown on jungle land and cost, including clearing, freight and other charges, Rs. 48 per acre to produce. The gross proceeds per acre including sale of seed were Rs. 162, the net returns Rs. 54.

The same piece of land has been sown again with cotton this season, the crop at the time of writing looking even better than that of last year. In view of the success of the trial, offers of Crown jungle land for cotton growing were made to *chena* cultivators on special terms by the Assistant Government Agent and applications were received from various private individuals in the locality but too close on to the October rains to permit of time for much to be planted. Thirty-one acres were however taken up at a nominal rental of Rs. 1 per acre and sown; reports as to the condition of the crops being now very satisfactory.

Hambantota has an average annual rainfall of 36 inches and, what is most important for cotton, a fairly reliable dry season for harvest.

In the case of the other plots unseasonable (from the point of view of the cotton planter) rains either stimulated the growth of leaf and stalk at the expense of boll, or dashed the crop when it opened.

For the October and November sowing the Agents of the British Cotton Growing Association in Colombo distributed to different parts of the island seed sufficient for 380 acres—an indication of the endeavours that are being made to establish a cotton industry in Ceylon. So far as they have gone the trials referred to above confirm the results previously obtained at Maha-iluppalama, namely, that the main portion of our so-called dry zone is unsuitable for cotton as a staple crop. But it is easier to show cotton to be an unsuitable crop for a particular locality than to prove that it is suitable for another because, as with all crops, it must be shown before confidence is gained that the chance of failure is reasonably remote. At Hambantota we have had one good year and there is now the promise of another which is decidedly encouraging. The only other part of the island with climatic conditions corresponding to those of Hambantota is the district of Mannar with an average annual rainfall of 38 inches and it is in these two districts that the cultivation of cotton is we think most likely to prove successful. In both localities there is a large amount of land available that is now unproductive.

R. N. L.

PLANT & SEED SUPPLIES TO MEMBERS OF C.A.S.

A supply of grafted plants will be available to members of the Ceylon Agricultural Society at the Government Stock Garden, Colombo, early in May. The varieties include :—

Mangoes.		Other Varieties.	
Alponso or Badami.	Lime	...	Bangalore variety
Raspuri	Lemon	...	do do
Mulgoa	Citron	...	Very large
Goa	Pomegranate	...	Bangalore large
Oranges.	Sweetlime	...	Large fruited
Coorg	Guava	...	Pear
Satkadi	Roseapple	...	Bangalore variety
Nagpore	Grape	...	Black Hamburg
Sylhet	do	...	Gordo Blanco
Other Varieties.	do	...	Muscat of Alexandria
Pomelo	Figs	...	Brown Turkey.

N.B.—All these are grafted plants except Lemon, Grape and Fig.

The charge per plant will be Rs. 1·50 each, payable in advance. Orders with remittances may be booked at once. Applications will receive attention in the order of receipt.

ENGLISH VEGETABLE SEEDS.

The usual supply is expected to reach the Government Stock Garden early in May : cost 10 cents per packet. Orders may be placed now. The varieties available are :—

Artichoke	Endive
Asparagus	Fennel
Beans (Dwarf French)	Kohl Rabi (knol khol)
Beet	Leek
Borecole	Lettuce (Cos)
Broccoli	Lettuce (Cabbage)
Brussels Sprouts	Onion
Cabbage	Parsley
Cabbage (Savoy)	Parsnip
Capsicum	Peas
Cardoon	Radish
Carrot	Rhubarb
Cauliflower	Salsify
Celery	Spinach
Chili	Tomato
Cucumber (ridge)	Turnip
Cress	Vegetable Marrow

C. DRIEBERG,

Secretary, C.A.S.

30-3-14.

RUBBER.

LEAF DISEASES OF HEVEA.

In the Eastern Tropics, the leaf diseases which have been recorded for *Hevea brasiliensis* have been confined to nursery plants and have not caused serious damage. In South America, however, there would appear, from the accounts of different investigators, to be at least one which is more dangerous than those known in the East in that it attacks both old trees and nursery plants.

The fungus which causes the disease was first described by Hennings in 1904 under the name of *Dothidella Ulei*. The specimens had been collected by Ule in the Upper Amazon Valley, Jurua (Acre Territory), on the banks of the Rio Jurua Mirum (Acre Territory), and on the banks of the Amazon in the neighbourhood of Iquitos (Peru). Hennings did not give any account of the injuries caused by the fungus. Dr. Huber, however, on the occasion of his visit to Ceylon, stated that it sometimes caused serious damage and defoliated the trees.

Recently, the fungus has been re-described by Griffon and Maublanc, from specimens obtained on nursery plants at Belem. These authors do not consider that it is likely to cause a serious disease. They state that on old trees the injury is doubtless insignificant, and only nursery plants could be seriously injured. Griffon and Maublanc found, on the same leaves as the *Dothidella*, conidia and pycnidia which they regard as stages of that fungus, a discovery which gives occasion for a revision of the known facts relating to the leaf diseases of Hevea in South America.

In 1911, Dr. J. Kuyper described what was considered a different leaf disease of Hevea from Surinam. This disease occurs in three forms. In the first stage, the young leaves, only three to five days old, exhibit subtransparent, olive green or dark green patches, which are sometimes so numerous that the whole leaf blackens and collapses. In the nurseries, sometimes every plant is attacked. Hevea leaves grow rapidly and apparently the fungus cannot attack the older tissues. Consequently the disease is, in many cases, limited to the original spots, the centres of which turn yellow and fall out, so that the leaf becomes perforated. At the edges of the holes, small black bodies are produced, often in such numbers that they form a closed ring. This perforation of the leaf is Kuyper's second form. The fungus can also occur on the leaf stalks and stems, where it produces swollen areas which may form canker-like patches ; this is the third form.

The fungus of the surinam disease was described as a *Fusicladium*, and was named *Fusicladium macrosporum* Kuyper. It occurs on both *Hevea brasiliensis* and *H. guyanensis*. Kuyper states that nursery plants are often strongly attacked. Its occurrence is irregular, and that, he considers, may be accounted for by the fact that Hevea drops its leaves twice a year. After the leaf-fall, trees previously seriously attacked often produce sound shoots. For that reason, the injury resulting is small. Weak plants often die, and even

six-year old trees may succumb to repeated attacks. Kuyper advises that old trees which are repeatedly attacked should be removed, that plants which show the second stage should be sprayed with Bordeaux mixture to kill the spores which appear then, and that, in nurseries, upper parts of stems which bear the third stage should be cut off.

From a comparison of Kuyper's description and figures with those of Griffon and Maublanc, it would appear that these authors are dealing with the same fungus. The pycnidia and pycnospores described by Griffon and Maublanc are identical with those described by Kuyper as occurring with his *Fusicladium*, while the conidia of the former authors agree with the *Fusicladium* spores of Kuyper. An exact comparison cannot be made, as several essential details are omitted from the descriptions, but the coincidences are so close that there does not seem to be much room for doubt.

More recently, Bancroft has recorded another leaf-disease, from British Guiana. The symptoms were "a spotting of the leaves, followed by an increase in the size of the spots, with the production of dried areas which eventually fall away from the green parts leaving holes in the leaf surface." The disease is said to have been "not particularly abundant." Specimens of the fungus were forwarded to Kew, where it was considered to be a new species, and named *Passalora Heveæ* Mass. The description of the fungus is not available, but it may be pointed out that *Passalora* is a genus closely resembling *Fusicladium* and only doubtfully distinct from the latter. It would appear probable therefore that the British Guiana leaf disease is the same as those of Brazil and Surinam.

If these conclusions prove correct, Hevea throughout South America is subject to a leaf disease which can attack both old and young trees. It is unnecessary to point out the bearing of this on the proposal to establish plantations of Hevea in its native country.

T. P.

THE RUBBER MARKET.

The market in rubber, the commodity, has been good. The offerings at the next auctions are again likely to prove much below the figures at one time published. The demand for rubber round present prices is very keen. Considerable forward business has been passing. A general impression prevails that the commodity is going better. This feeling is evidenced by big manufacturing concerns making overtures direct to leading companies for their produce at prices above current market rates. A feature at the last auction sales was the reduction in the big premium which smoked sheet has so long commanded above crêpe. The relative variation of the prices of these two descriptions merely reflects the varying demand. The present exigent demand for rubber is purely the result of the stimulus of recent low prices. Any organised attempt to crib supplies and crab the market, as unwisely advocated in some quarters, would react prejudicially on the future of the industry. Rubber shares are on a far sounder permanent investment basis with rubber at 2*s*. 6*d* per lb. than at 3*s* per lb. A continuance of the present prices will yield magnificent profits to sound conpanies during 1914, and further stimulate manufacturing activity. We hope leading companies

will sell forward freely round 2*s.* 6*d.* Large scale manufacturers are not going to sink large sums of capital in new departures unless certain of their supplies of the raw material at a price likely to yield them a fair manufacturing profit on their capital. The share market has been active and strong. The 3 per cent. bank rate revolutionises the position of the first class dividend payers, which should steadily appreciate in value.—Investors' Chronicle.

RUBBER IN BRAZIL.

We have seen that in the vast Amazon valley, the home of the Hevea, there are excellent possibilities of laying out rubber plantations, the climate and soil, most important factors for assuring success, being particularly suitable.

M. Labroy is against giving up the machadinho, or little tapping hatchet of the seringueiro. All that is necessary," he maintains, on p. 42, " is to supervise the tapping a little and see that it is carried out so as not to harm the trees." As such supervision would be even more necessary with the tapping tools of the East, such a suggestion is not out of the way; at the same time, as more scientific methods find their way into the Brazilian seringals, tapping instruments of the farrier-knife type are certain to be found there, especially as many illustrations in the latter part of the report show such implements to be already used up the San Francisco River for tapping.

We agree with the contentions of those who maintain that it has yet to be proved that the excision methods of the East are better in the long run to the trees and to the yield than the incision methods of the machadinho of the West; harmful as the latter can prove when unskillfully used, yet taking circumstances into consideration the machadinho has many advantages.

Roughly speaking, the seringueiros are busiest between July and February, and after making allowances for illness, fetes etc., the average number of days throughout the year on which the trees are tapped ranges between 100 and 140. This leads us to the important question of yields. On the average an *estrada* has 135 trees, we believe (p. 39 says 80 to 170), and whilst a virgin *estrada* in the Upper Xingu has given 1,000 kilos of dried rubber, others average 200 to 300 kilos annually. This, we take it, is before the rubber has been left to drain and dry after the smoke curing, when, we are told, on p. 51, between the time of smoking and the sale at the port of shipment as much as, and generally near to, 50 per cent. of the original weight is lost.

The daily output of an average tree has been put at 22 gr. *borracha fina*, allowing that there are 140 days' tapping, 22 by 140 should give 3,080 gr. as the average yield per tree in a year, or, it is estimated, an average of 400 kilos per estrada.

Tropical Life.

INCISION AND EXCISION METHODS OF TAPPING.

F. G. SPRING.

For the purpose of making a comparison of these two systems one hundred 4-year-old rubber trees of approximately equal girth were selected, 50 trees being tapped with the serrated knife and the other 50 with the gouge. The trees tapped with the gouge were marked out on a single quarter system (half herring bone) with two cuts 18 inches apart and tapping was conducted every day at the rate of approximately 20 cuts to the inch. The Northway 4-Point Serrated Knife was used in the other area and tapping conducted on the single quarter system. The following directions for the use of the serrated knife were adopted and are taken from a circular issued by the agents. "The trees may be tapped on the half or full "herring bone" principle. The following describes the half "herring bone" system:— A narrow vertical channel is cut in the tree up to a height of 5 feet or more (according to age and size) from its base for carrying the latex. The "Northway Gouge" knife, or any other paring knife, may be conveniently used for this. A space about 1½ inches wide on one side of the channel is then scraped to remove dry bark or other inequalities of surface.

The following are the results obtained over a period of five months :—

	Serrated Knife.				Gouge.					
	Latex Rubber.		Scrap.		Latex Rubber.		Scrap.		Bark Shaving.	
	lb.	oz.	lb.	oz.	lb.	oz.	lb.	oz.	lb.	oz.
7th June to 6th July, 1912	2	11½	1	6	2	8	1	3½	...	
7th July to 6th Aug. ,,	4	1½	1	15	5	3½	1	11½	...	
7th Aug. to 6th Sept. ,,	6	11	1	10	4	8½	1	8	...	
7th Sept. to 6th Oct. ,,	6	2	1	4½	5	5	1	9½	...	
7th Oct. to 6th Nov. ,,	6	1½	1	9	7	10½	1	6	...	
Total ...	25	11½	7	12½	25	3½	7	6½	1	12

Total Rubber—Serrated Knife=33 lb. 8 oz.
Total Rubber—Gouge =34 ,, 6 ,,

As far as yield is concerned there is practically no difference in the two systems over a period of the first five months' tapping. As the girth of the trees increases there will be a corresponding increase in the length of the cuts where gouge tapping is conducted and a consequent increase in yield in this system, but in the other plot the same increase in yield can hardly be expected as the size of the cuts always remains the same, and if the number of cuts be increased as the tree becomes older, to more than five one foot sections, tapping becomes more difficult and expensive. The next point to

be considered is cost of labour in the two areas. I find that when using the Northway Serrated Knife the cost of labour is about double that where the gouge is used, an important point on an estate. The time lost in using the serrated knife I found due to the following :—

1. Placing the knife at the correct angle in five separate sections.
2. Guiding the latex.
3. Collecting scrap.

After a period of five months' tapping the trees were left untapped for one year and then closely examined. As regards the health of the tree in the case of the gouge it is unnecessary to deal, as it is well known that renewal of bark depends largely on the quality of tapping. In the case of the serrated knife no injury to the tree could be found.—F.M.S. Agricultural Bulletin.

SEEDS DORMANT UNDER GAS.

In a communication made to the Royal Society yesterday (March 5) Mr. F. Kidd showed that the germination of seeds is completely inhibited in an atmosphere containing from 20 to 30 per cent. of carbonic acid gas, according to the temperatures used. No injury is done to the seeds, which germinate at once when removed from the carbonic acid atmosphere. The seeds of white mustard, however, are an exception. They do not germinate on removal to ordinary air, the inhibition continuing indefinitely, even though they lie in well aerated and moist conditions at a temperature of 15° to 20° C. They germinate, however, if their testas are removed or if they are completely dried and then re-wetted.

Experiments in the field have shown that this action of carbonic acid may actually occur in nature. If a quantity of green material is placed deep in the ground the carbonic acid produced by its decay will inhibit the germination of seeds planted above it. This observation is of agricultural significance, and the fact that in the case of mustard seeds suspension of vitality continues, even after the external carbonic acid has been removed, suggests an explanation of the common occurrence of such seeds lying dormant in fields, and possibly of other natural causes of delayed germination.—The Mail.

GHEE.

Copra oil has a new rival in India. Ghee, or boiled butter, prepared chiefly from milk of carabayas and cows, is used by about one-fourth of the entire population of India, the total consumption being some 3 or 4 kilos per capita per year, or in all about 267,000 tons. The present high price of ghee, however, is forcing the poorer classes to substitute some vegetable oil therefor in cooking. The high price of copra practically prohibits the use of coconut oil although this is still used to a great extent in Ceylon. Cotton-seed oil is now coming into common use and is, of course, considerably cheaper than even the poorest grades of ghee now on the Indian market.—Philippine Agricultural Review.

COCONUTS.

CONSOLS OF THE EAST.

The interest which has been aroused in coconut cultivation during recent years is well evidenced by the steady output of literature on the subject. Among recent issues, we are glad to be able to chronicle the re-appearance of Messrs. Hamel Smith and Pape's "Coconuts : the Consols of the East," which, first published in 1912, has now worthily attained the dignity of a second, and enlarged, edition.

As in the first edition, Sir William Lever provides a "Foreword," in which he records his opinion that, strong as was the case for the profitable outlook of coconut planting when the first edition was issued, it is stronger to-day, owing to the extended use of Coconut oil for the preparation of butter substitutes. At the same time, Sir William Lever takes advantage of the opportunity to point out, as Mr. Hamel Smith had already done, that isolated sentences from his previous "Foreword" had been quoted by "the more or less undesirable class of company promoter" to exploit the public for their own ends and to draw money from the pockets of the ignorant and careless investor. With regard to the objections which have been raised to Sir William's estimate that "the amount of capital required to become the possessor of a rich coconut plantation is not excessive, and should not exceed £10 to £12 per acre, including every expense except the planter's own labour and interest on capital," he emphasizes the fact that these figures, as shown by his statement, do not include the price paid for land and buildings interest on capital, cost of management, etc.

The second edition contains 130 pages more than its predecessor. The chapter on the mechanical extraction of fibre has been re-written, and the former illustrations replaced by others of newer machines. The chapters on irrigation and stump extraction have been discarded in favour of new chapters on The Cost of making Copra, Expenditure and Revenue in Trinidad, Samoa in 1913, The Nasicornus Beetle Fungus, Coconut planting in Fiji, Coconuts in the Solomon Islands, Remounts for the Army, Farming with Dynamite, and General Notes.

The practice of adopting *in extenso* accounts written by observers in different countries involves considerable repetition, but probably the authors have gauged correctly the public demand and the method of presentation desired by the intending planter. Still, it is scarcely necessary to bring forward Mr. Brown's erroneous views on the pollination of the coconut if they are to be immediately contradicted by Dr. Fredholm's actual observations. Moreover, this practice in some cases gives the reader totally incorrect ideas, as for example in the case of the Coconut beetles, red and black, which are referred to by various writers under their popular names regardless of the fact that these names may denote different beetles in different countries.

That the book is up to date is evident from the inclusion of an account of Dr. Friedrich's experiments with the coconut beetle fungus in Samoa, the results of which will be awaited with interest. The fungus, by the way, is found (if the identification is correct) in both the East and the West Indies, and therefore probably occurs throughout the Tropics. Ceylon owes a debt of gratitude to Messrs. Hamel Smith and Pape for their forbearance in omitting to repeat the totally unsupported story that the rhinoceros beetle was introduced into Samoa from Ceylon. This is a repetition of the fables which were promulgated about the distribution of the coffee leaf disease, and which are now admitted to be quite without foundation.

The chapter on diseases remains the same as in the first edition. This chapter is not a very satisfactory one, and stands considerably in need of revision. The diseases of coconuts are not numerous, and it should be possible to give a full and coherent account of them within the fifty pages allotted to the subject. As it is, much of the available space is devoted to cases of disease which were never fully investigated, and the information is therefore of uncertain application. The authors exhibit a reluctance to discard information which has been proved to be incorrect. *Pestalozzia palmarum*, for example, is not the cause of budrot. On the other hand, the only cause of root disease which has a reasonable probability of having been correctly determined is not mentioned.

The book provides a wealth of information, displayed in a lively and attractive style, and cannot fail to fulfil its avowed mission of bringing the possibilities of coconut cultivation prominently before investors and financiers.

T. P.

COCONUTS IN PANAMA.

The San Blas coconut of Panama still maintains its reputed superiority over all other varieties of the world. It is not only large but it is a "free sheller," i.e., the meat readily separates from the shell at the time of breaking, thus giving it a great advantage in the hands of confectionery and "shredded" coconut manufacturers in the United States. The raw nuts are shipped in the shell, of course, to the Eastern States for manufacture. The average market price for these nuts is from 60 to 90 per thousand, but over 100 per thousand has recently been obtained in New York for "select San Blas"—the price at Colon remaining fairly steady at about 0·06 per nut. As in the Philippine Islands, the common varieties of coconuts in Panama and Costa Rica are the "green" and "yellow," although a "red" and four or five other sorts are cultivated to a slight extent. Under ordinary conditions, which does not mean modern methods, a tree in Panama is expected to yield 6 to 10 nuts per month.—Philippine Agric. Review.

OLIVE OIL.

The olive-oil output of Greece is estimated at about 19 million kilos for 1913 as compared with 22,500,000 kilos in 1911; this substantial reduction in output of this oil is one of the contributory factors in the present high price of copra.—Philippine Agricultural Review.

COCONUTS AT PAPUA.

A correspondent writes :—"Papua is a fine coconut country. I have opened up three thousand five hundred acres of coconuts since I went out there about five years ago. We have trees well under five years carrying a crop, and showing very good promise. The average of the old native-planted trees work out to 57 nuts per tree per annum, so with cultivation you can just imagine what could be expected. The Copra average of this estate (we only dry a few tons a year as the place is very young) is 4,600 unselected coconuts for well dried copra. You will also be glad to hear that we have an area of 15,000 Ceylon coconuts planted out which are doing very well. I shall send you a set of prints of photos of plantation views."

COCONUTS IN THE PHILIPPINES AND F.M.S.

Coconut planting is rapidly gaining in favour and prices are very satisfactory, copra having advanced considerably in value; the area in coconuts in the Federated Malaya States is estimated at about 63,000 hectares (157,600 acres), the area in the Philippine Islands being roughly between 220, 000 and 250,000 hectares.—Philippine Agric, Review.

COPRA.

Copra shipments from Java, and in fact from all of the Dutch East Indies, are steadily increasing; in 1912 Java alone supplied more than 100,000 tons of copra valued at over 15 million pesos. The total copra export of Dutch East Indies will probably amount to well over 200,000 tons this year, which means that the Philippines can no longer boast of being at the top of the list of copra-producing countries, and, with East Africa, the Malay States, and Tropical America forging ahead in this industry, our place is dropping down the list and unless modern methods are adopted here soon this country, which a few years ago was looked up to as one of the two greatest copra countries of the world, will be deplorably outclassed.—Philippine Agric. Review.

SOYA BEAN.

As was confidently expected, the soya bean has been greatly improved in the past few years, both in America and Europe. Whereas in its home country of Manchuria the oil content is only about 15 or 16 per cent., some of the new varieties which have been bred up in America and Europe run as high as 20 and even 22 per cent. South Africa is now taking up this crop and it is found that altitude somewhat affects the yield of oil in any given variety; for instance, at an altitude of 1,000 meters the yield of a certain variety is about 20 per cent. while at sea level it is about 22 per cent. Germany, ranking with France as the heaviest importer of all seeds, has been trying for years to find a suitable oil crop which could be put under intensive cultivation; this desire seems about to be realized in the shape of soya, many varieties of which can now most likely be grown in Germany with excellent success. In 1912 Germany imported 1,443,447 metric tons of oil seeds valued at 217 million pesos.—Philippine Agricultural Review.

RICE.

HOW TO IMPROVE PADDY CULTIVATION IN CEYLON.

Mr. R. Chelvadurai Proctor, Tamil Interpreter Mudaliyar, Supreme Court, Colombo, has sent us a comprehensive article on the question of Paddy Cultivation in Ceylon. Having reviewed the past history of the industry, Mr. Proctor proceeds as follows :—The saved up capital to the credit of the Paddy industry is vast, as witness the numerous tanks and stretches of terraced paddy fields scattered all over the Island. The accumulated knowledge as regards the working up of the industry economically and with success among the operatives is above cavil. The personal qualities of the peasant are excellent in spite of exploitation by capital. He is honest, steady, obedient to authority, always conciliatory in spirit and willing to co-operate—qualities requisite to efficient production.

It has been said that "paddy-growing is something more than an industry in Ceylon ; it is a religion with a liturgy." This is true in a sense. Many rational things connected with the industry here are, no doubt, entangled in religion. To the peasant religion presents a material side also. Some four years ago the writer's paddy plants were invaded by a pest of flies. His *goiyas* tried some remedies, and failing to reduce the pest asked his permission to hold a "religious ceremony," viz., "to boil rice in milk and offer same in worship of the village god to rid the pest." The permission was reluctantly given. A site was selected under a tree near the field. Fire kindled, and as the smoke rose some crows were seen coming to the scene. Cooking done, some boiled rice was "offered to god" by placing some under another tree and the rest partaken by the *goiyas*. The leaf-plates from which they ate their rice were thrown about with remnants. This "ceremony" called to the scene more birds. The *goiyas* returned to their homes, but the birds remained there to feast, and in two days' time the field was well ridden of the pest. The presentation of religion through an industry is a feature in the economic scheme of the East. In the case of paddy cultivators, probably it was early felt that so large a body engaged in so noble a calling as production of corn should be guarded against giving themselves up to banality and banal associations. The whole social structure seems to give evidence of anxious concern to keep the corn producer alive for all times to come to the responsibilities of his high estate. However that may be, it is undisputed that the religious sense of the peasant in relation to his industry is alive today; and this makes for peace, harmony and contentment.

The paddy cultivator asks for fair treatment and restoration of those free conditions under which his ancestors lived and carried on their industry ; in plain words, he wants reform on "historic lines."

In this connection the following suggestions are offered for consideration:—

(1) The Agricultural Department should be invested with authority to guide and control the activities of the Land Settlement, Irrigation, and Survey Departments; or appoint Boards of Control in the various provinces to exercise functions as *media* of co-ordination.

(2) Substitute in place of outright sales a system of leases of Crown lands in the villages. The villagers will be pleased to become tenant-farmers under the Crown.

(3) Where it is found expedient or necessary to sell Crown lands *in the villages*, let pre-emption rights be recognised as in Jaffna, and lands be offered for sale to bona fide paddy cultivators, not by competition, but at reasonable prices. Where a neighbouring cultivator is anxious to buy, but unable to pay owing to lack of funds, he should be allowed to pay by instalments under certain guarantee, through an agricultural bank or other village organisation.

(4) Appurtenant jungle to paddy lands should not be alienated by the Crown, except for purposes of extension of paddy cultivation. The first steps to *aswedumization* being chena cultivation, a liberal grant of permits for *chenaing* appurtenant jungles may be issued to bona fide paddy cultivators.

(5) Surveys should be ordered without delay of *catchment areas* of village tanks. The 'areas' should be demarcated and given over to Village Councils. It should be the duty of Village Councils to see these 'areas' to be preserved, as far as possible, in ever-green jungle. Such revenue as may be derived through issue of licenses to shoot game and sales of forest produce on these 'areas' should go to Village Councils to be applied for the improvement of Communal properties in villages.

(6) In villages where it is found that "catchment areas" had been sold to outside capitalists, and utility of tanks permanently injured, the villagers should be compelled to perform service on the bunds.

(7) The Village Councils and Gansabawas may be reformed on the lines of *Panchayats* of India. The bona fide villager should be given a larger measure of self-government in the management of affairs of his own village.

(8) It should be within the authority of Village Councils to punish criminally *goiyas* who, having entered into an agreement to cultivate a *gamarala*'s field on profit-sharing system (according to the usages of paddy cultivation), failed or neglected to perform their work during season of cultivation—usually six months.

(9) Communal lands being lands reserved for the benefit of paddy cultivation, some provision in law should be made to exclude outsiders from using them.

(10) In villages where appurtenant jungles and catchment areas had been sold out, Government may be asked to acquire lands for use as village pasture.

(11) In villages where the inhabitants are too poor to bear the cost of repairing of tanks and channels, provision should be made to advance them money to be amortized by easy instalments in produce.

(12) Government may introduce a system of conferring native ranks on some of the largest producers of paddy through employment of labour on the old "profit-sharing" system. Larger employment of profit-sharing labour should be encouraged as much as possible, for, this will be the means of drawing "back to the land" many cultivators who during recent times, have become landless.

These suggestions do not cover the whole list of the peasant's wants, but if accepted, it is hoped, his principal causes of discontent will be removed and will also serve to give a new life to the industry. In a country such as ours where birth, and not contract, settles one's industry, any assistance, however slight, rendered to an industry will be greatly appreciated for, being wedded to an industry by birth, the operatives feel that they must stick to it even under hardships. Oppression therefore becomes doubly cruel. While nationalisation of land is a dream in England, it was a reality here, at least in the villages, till capitalism overthrows ancient usages and manners.

GREEN MANURES FOR PADDY.

The Agricultural Department of Mysore, of which Dr. Leslie Coleman is the able head, has given considerable attention to this question and in view of the trials now going on locally in connection with the growing of sunn hemp (*Crotalaria juncea*) as a preparatory crop for paddy, the information given below, extracted from Dr. Coleman's reports should prove useful.

The following table shows the amount of manurial matter in legume commonly grown as green manures for paddy :—

Name of Plant.	Botanical Name.	Nitrogen per cent.	Green cuttings per acre. lb.	Nitrogen per acre, lb.	Lime per cent.	Phosphoric acid per cent.	Potash per cent.	Remarks.
Sunn hemp	Crotalaria juncea	0·75	4,300	32	0·39	0·12	0·51	Average of 7 samples.
Cow pea	Vigna catiang	0·705	4 300	30	0·64	0·15	0·53	Average of 4 samples.
Green gram	Phaseolus mungo	0·72	3,200	23	0·76	0·18	0·53	Average of 7 samples.
Lab-lab	Dolichos lablab	0·75	2,400	18	0·67	0·16	0·56	Average of 8 samples
Horse gram	Dolichos bifloria	0·50	3,400	17	—	—	—	—
Black gram	Phaseolus mungo, var radiatus	0·85	1,600	13·6	0·74	0·18	0·53	Average of 6 samples

The Sinhalese names of the above are (1) Sunn hemp, hana ; (2) Cow pea, gas mé ; (3) Green gram, mun ; (4) Lab-lab, mocha ; (5) horse gram, kollu ; (6) Black gram, ulundu.

To get an idea of the actual amount of nitrogen added to the soil by a green manure crop, the amount of growth that the plant can make in the available amount of time, for instance eight or ten weeks, must also be taken into consideration along with its nitrogen content. The weights of green cuttings per acre that have been obtained by growing the plants for about eight weeks under similar conditions are also given in the Table given above. From this table it is seen that sunn-hemp and cow pea make the largest amount of growth, yielding on an average about 4,300 lb. of green material per acre. Next comes green gram with 3,200 lb. per acre. Lab-lab yields 2,400 lb. and black gram only 1,800 lb. per acre. When these figures are considered along with the nitrogen content of the plants, it is seen that a crop of sunn-hemp adds the largest amount of nitrogen to the soil, e.g., about 32

lb. to the acre. Of the other plants, cow pea adds 30 lb., green gram 27 lb., lab-lab 27 lb., black gram 13·6 lb. to the acre. Hence it is seen, that though black gram contains the highest amount of nitrogen per plant, it is not capable of adding even half the quantity of nitrogen that can be added by either sunn hemp or cow pea for the reason that it does not grow so luxuriantly as either of these plants.

In addition to nitrogen, a lot of easily decomposing organic matter is added to the soil when green crops are ploughed in. When this organic matter ferments and decomposes in the soil, large quantities of carbonic acid are given off and this helps the soil water to attack and dissolve the plant food in soil. The organic matter also furnishes a supply of humus for absorbing and holding moisture, and for improving the texture of the land. By a system of green manuring, many a hungry soil may be made capable of retaining water and manure, and so of supporting crops.

The best time for ploughing in green crops grown upon the land is when they are in flower. By that time, they will have gathered from the soil and the air almost everything that they are capable of doing. But if the plants are allowed to fruit and the fruit harvested a great deal of nitrogen will be lost to the soil. When they are ploughed under at that stage, the land is furnished with everything that the plants have accumulated either from the air or from the soil or from the water in the soil, and there is placed within the land a mass of soft, green and succulent organic matter.

Sunn hemp is a plant that makes very good growth under normal conditions. In the course of eight or ten weeks, it is capable of growing to a height of about six or eight feet under favourable conditions, and of yielding up to 8,000 lb. of green cuttings to the acre at times. Since the seeds, even when they are allowed to form, are not required for human consumption, there is no temptation to collect them. When cattle are allowed to graze for some time in the fields, they do not eat much beyond the tender tops of the plants. On the whole, it is a plant very well suited for green-manuring paddy fields and its cultivation should be extended as much as possible.

For green manure the seed may be sown at the rate of 24 lb. per acre. The crop should be cut at the proper time and after the first ploughing it should be spread evenly and trampled in.

C. D.

THE CULTIVATION AND PREPARATION OF RICE.

There are several species of the genus Oryza, the family of grasses to which the rice-plant belongs, but the species of greatest importance is *Oryza sativa*, Linn., the common or aquatic rice-plant of which there is an immense number of cultivated varieties. The wild plant from which the cultivated forms have been derived has been found growing naturally in marshy places in Southern India and Indo-China, and in all probability this region is its original home. Other forms of wild rice, which as far as the structure of the spikelets is concerned might be considered conspecific with *O. sativa*, have been found in North Australia, Borneo, tropical Africa and South America. The Canadian wild rice (*Zizania aquatica*, Linn) and the Manchurian "water-rice" (*Z. latifolia* Turez.) are quite distinct from the true rices.

The cultivated rice plant is an annual with stems varying in height from 1 to 6 or more feet furnished with tapering leaves 1 to 2 feet in length, and upwards of 1 inch in width; the flowers are produced in one-flowered spikelets, in panicles 8 in. to 1 ft. in length, that are at first erect but become arched as the grain ripens; the two pales are persistent, forming the "husk" of the ripe grain, and in some varieties the lower pale is furnished with a stiff awn of considerable length; the grain is enclosed in, but does not adhere to, the persistent pales. The cultivated rices vary greatly in habit of growth and also in the size, shape, weight, colour, consistence, and properties of the grain. Rice, like wheat, will throw up a number of culms if the plants are not too crowded, a process known as "tillering."

Several attempts have been made by botanists to classify the numerous forms of cultivated rice; the most useful systems for practical purposes are those based on the cultural requirements of the plants and their periods of growth. The Japanese botanist, Kikkawa, who has had exceptional opportunities for studying the forms of rice cultivated in the East, has published a useful paper on their classification in the Journal of the College of Agricultural University of Tokyo (1912, 3 No. 2. p.11). In this paper, the classification proposed groups the varieties according to their habit of growth and cultural requirements, and also according to the characters of the grain. A summary of the grouping used for the classification according to cultural requirements and habit of growth is as follows:—

(A) Aquatic or Lowland Rice.
(a) early; (b) medium; (c) late.
I. Ordinary Rice.
(a) tall; (b) medium; (c) short.
(1) awned; (2) awnless.
II. Special Rice.
(a) giant; (b) salt.

(B) Upland or Hill Rice.
(a) early; (b) medium; (c) late.
(a) tall; (b) medium; (c) short
(1) awned; (2) awnless.

The points of distinction used for classifying the varieties, including both aquatic and upland rices, according to the grain are:

(A) Non-glutinous Rice.
I. Slender-grained. II. Long-grained. III. Short-grained.
1. Large-grained. 2. Medium-grained. 3. Small-grained.
(a) Common coloured.
(a) Ordinary. (b) Scented.
(b) Specially coloured.

(B) Glutinous Rice.
I. Slender-grained. II. Long-grained. III. Short-grained.
1. Large-grained. 2. Medium-grained. 3. Small-grained.
(a) Common Coloured. (b) Specially coloured.

The primary grouping into aquatic and upland varieties is recognised in most rice-growing countries, but Kikkawa points out that in Japan some of the so-called upland rices grow and yield better in flooded fields than in ordinary fields; on the other hand, there are some Indian lowland forms that only need flooding during the germinating period; hence it is impossible to draw a hard and fast line separating these two groups. It is probable,

however, that the true upland rices are derived from distinct species that have their natural habitat in mountain regions, such as *Oryza granulata*, Nees, and *O. latifolia*, Desv.; but as the upland forms have no distinctive morphological characters their origin is somewhat difficult to account for. Watt considers they have descended from the variety *O. sativa* known as *abuensis*, which occurs wild on Mount Abu, Rajputana.

The grouping of the varieties into early and late kinds is also a familiar classification for practical purposes in all rice-growing countries. Where climatic conditions are favourable, and the necessary water supply is available, it is possible to raise several crops during the year, and to suit the local conditions that prevail at different periods special varieties of rice have been evolved. Thus in some parts of India five distinct seasonal groups are recognised; they are:—

		Sown.	Harvested.
1.	"Aud" or early autumn rice ...	April-May	July-September.
2.	"Aman" or winter rice ...	May	November.
3.	"Boro" (khariff) or autumn rice...	June-July	September-October
4.	"Boro" (rabi) or spring rice ...	October-Nov.	May
5.	"Raydra"	December	September-October

In Siam there are two seasonal groups, viz:—

		Sown.	Harvested.
1.	"Khao bao"	January-February	May-June
2.	"Khao nak"	June-July	December-January.

In Japan the time of sowing varies with the district, and may differ according to variety, but in most cases all varieties in one district are sown at the same time. The early varieties ripen in from four to five and a half months, the medium varieties in from five to six months, and the late varieties in from five and a half to six and three-quarter months. In Burma the following groups of varieties are known: "Kaukkyi," which ripen in five to five and a half months and are harvested in January; "Kauklab," ripening in four to four and a half months and harvested in December; and "Kaukyin," which take only three months to ripen and are harvested in November. In most of the rice-producing countries similar groups of varieties are grown. The term "giant rice" is proposed by Kikkawa for certain forms that grow beyond the normal height of ordinary rice, which is usually above 3 ft., and seldom exceeds 6 ft. In Siam and certain parts of India the stems of "giant rice" have been known to reach a length of from 10 to 15 feet. As they seem to possess the property of growing taller as the water rises, these "giant rices" have their value in districts liable to flooding, and where the depth of the water cannot be controlled.

Fresh water is required for most cultivated rices, but there are a few varieties, known as "salt rices," that will grow in situations that are liable to be flooded with sea-water. Certain rices of the Bombay Presidency and of the Philippines belong to this category; and it would appear that some of the Egyptian varieties are also able to resist the action of salt in the soil, as rice is one of the crops recommended for cleansing salt land in Egypt.

The glutinous properties of some forms of rice grain have been observed from ancient times, and the grouping into glutinous and non-glutinous varieties is well understood. There are, however, few striking morphological characters to distinguish the plants that yield these two kinds of grain, except that the glutinous varieties are said to produce more tender leaves and stems than the non-glutinous kinds. The grain of glutinous rice is readily distinguished when ripe and well dried, owing to its opaque, chalky appearance, as against the wax-like, and semi-translucent grain of the non-glutinous rice; when steamed the former becomes transparent and sticky. Rice obtained from the "Kaukyin" varieties of Burma is said to be so glutinous that it will not stand the boiling required by ordinary rice, and is used for making various kinds of sweetmeats. In China only 20 to 30 per cent. of the total amount of rice cultivated is glutinous. It is occasionally cooked and eaten as a change from ordinary rice, the common method of preparation being to roast the grain after it has been steamed to form a kind of "popped corn."

Hooper states (*Agric. Ledger*, 1908-9, No. 5, p. 75) that the glutinous property is probably dependent solely on the carbohydrate constituents of the grain. According to J. Shimoyama (quoted by Kikkawa *loc. cit.*) the endosperm of glutinous rice contains only a small amount of common starch, with a small percentage of soluble starch and dextrin as well as some maltose. The grains of both glutinous and non-glutinous rices vary greatly in size, shape, and colour; in some cases only the outer skin is coloured, in others the grain is coloured throughout.

CLIMATIC CONDITIONS AND SOIL REQUIREMENTS.

Rice is naturally a tropical plant, but under cultivation it grows well in sub-tropical regions, although in such localities it requires a longer period for development. The principal rice-producing areas of the world are situated within a zone that extends as far as 45° North latitude in some parts of the Old World (e.g., valley of the Po river, Italy), but in the United States of North America is some 10° farther south. In the southern hemisphere, with a few exceptions, the zone does not extend far south of the Tropic of Capricorn. For its successful cultivation rice requires full exposure to bright sunshine, an average day temperature of above 70° F., with a warm night temperature and a heavy rainfall, or a supply of fresh water sufficient to inundate the soil during the period of growth. It is in this last-named requirement that aquatic or swamp rice differs from all other cultivated cereals. The upland varieties of rice need no more soil moisture than ordinary cereal crops provided the atmosphere is humid; but these varieties are grown on much smaller scale than are the aquatic kinds. With the zone above mentioned, whenever fresh water be economically applied to the land, rice can usually be grown as a profitable crop. For the most part, the water necessary for flooding the fields is supplied and controlled by artificial systems of irrigation, and only in certain districts, such as, for instance, the delta zone in Burma and parts of Siam, is the rainfall sufficient to inundate the fields without the help of artificial irrigation. In Eastern countries there are numerous contrivances of a primitive nature, usually involving a large amount of manual labour, for raising the water for irrigating rice fields; but in the United States of North America, where labour is expensive, and rice is cultivated by modern methods, a large part of the water supply is obtained from artesian wells, and is raised to the necessary level by means of power-driven pumps

In respect of soil, rice shows great adaptability, provided inundation is possible during the period of growth. The soil most generally in favour is a rich clay-loam, over-laying a subsoil of stiff clay, as such a soil will retain surface water even when situated at a considerable altitude. Rice can, however, be grown on a variety of soils of a lighter character if they are sufficiently low-lying to admit of being flooded and of retaining surface water. Although flooded fields are essential to the growth of lowland rice, good drainage is also necessary, as the complete withdrawal of the water prior to the ripening period provides the conditions most favourable to the proper maturing of the crop. Good drainage also allows of the more thorough cultivation of the soil and permits of its becoming sufficiently firm to support the heavy machinery that under modern methods of rice cultivation is now employed for harvesting the crop. Moreover, where the land is sufficiently drained, crop rotation can be practised, to the great benefit of the rice. In Japan, for example, naked barley and wheat are grown after rice as cold-season crops, whilst in Java rice is grown in rotation with maize, ground nuts, soy beans and other legumes, capsicums, sweet potatoes, millets, and tobacco. If possible, the land chosen for rice culture should be level, with sufficient slope to admit of ready drainage. On such land it is possible to maintain a fairly uniform depth of surface water, and this conduces to the regular maturing of the crop. Land of uneven contour requires more elaborate banking to form level plots or fields on which surface water will stand at an even depth, and this naturally involves more labour and adds to the cost of production.

SEED SELECTION.

It is important that the grain intended for sowing should be carefully selected with a view to securing seed of high germinative power, true to type and free from red grains. Light grains which usually fail to germinate may be eliminated from grains intended for sowing by winnowing or, more effectively, by floating off in salt water; the latter being the method commonly practised in Japan. To keep the grain true to type it is advisable to collect separately, previous to the harvest, the finest heads from the best yielding plants of the particular variety found to be the best suited to the locality, and to reserve the grain obtained from these for sowing purposes. The crop obtained from seeds so selected should be subjected to a similar process of a selection during subsequent harvest until the type has become "fixed." The mixing of seed intended for sowing is strongly deprecated, as it is probably due to this practice and to the absence of any selective methods that the quality of rice has undergone the deterioration which is said to have taken place during recent years in some rice-producing countries. A recent study of the varieties of rice grown in Lower Bengal has shown that although rice is normally self-fertilised, cross-fertilisation may occasionally take place between adjacent plants through the agency of the wind. So long as all the plants in a plot are true to type, there is no risk of contamination from cross-fertilisation, but should the seed used for sowing be mixed, it would result in reducing a variety to a number of splitting types in a few years (cf. *Mem. Dept. Agric. India, Bot. Ser.* 1913, 6, No. 1). The elimination of red grains is important, if the crop is intended for export, as the presence of red grains in samples of milled "white" rice lowers the commercial value of the latter considerably, and there are no methods of milling by which red grains can be

separated from white when the two kinds are mixed together. For milling purposes the grains should be regular in size, large and heavy, long and cylindrical in shape, as such kinds are less liable to get broken during the milling processes than are flat or "turtile-grained" varieties. A small embryo or "germ," a thin, awnless husk, and a hard, translucent kernel capable of taking a high polish are other desirable qualities. The nitrogenous qualities and weight of the grain may be improved by cultivation, by the addition of suitable manures to the soil, or by growing the grain on virgin land. The breaking of the grain is frequently due to careless harvesting, and is not in all cases an inherent defect in the variety of rice.

An increased yield may sometimes be obtained by sowing seed from some other locality. Before this is done on a large scale, however, it is advisable to test the new variety by growing on an experimental plot, otherwise loss may result. Obviously a variety requiring six months to mature cannot succeed where the climatic conditions and water supply are only suitable for variety ripening in from three to four months, and there are other less striking peculiarities that require to be ascertained experimentally before changing seed on a large scale.

MANURES.

Owing to the saturated condition of the soil essential to the growth of lowland rice, the selection of a suitable manure for this crop is a matter of some difficulty. Where the land is naturally flooded or, in some cases, where river water is used for irrigation, a layer of silt is deposited by the water standing on the soil, which is to a varying extent enriched thereby, and little manuring is required. In common with other cereal crops, rice withdraws nitrogen, phosphoric acid, and potash from the soil, and these constituents require to be present in manures intended to restore fertility to rice lands. Very little systematic manuring is done in rice-producing countries, but recent experiments in India and elsewhere have shown that the yield can be increased considerably by the judicious use of suitable manures. On the other hand, if the crop is unduly stimulated it is liable to produce a rank growth of straw, accompanied by a poor yield of grain. Experiments on the Central Farm, Coimbatore, have shown that bulky organic manures applied to rice fields give better results than manures of similar value but containing little organic matter. In Oriental countries where manuring is practised, the manures most in favour for rice are green manures, oil-cake, farmyard manure, night soil, and fish manure, all of which contain a considerable amount of organic matter that on decomposing serves to increase the amount of humus in the soil and to improve its physical properties. Nitrates are unsuitable as rice manures, as they are soluble in water and liable to be washed away, whereas compounds that yield ammonia in rice lands are valuable, as the rice plant readily absorbs ammonia, which, although soluble in water, is retained by the soil to a much greater extent than are nitrates. Recent experiments with cyanamide, which yields ammonia in rice soils, have given promising results, and it may possibly prove useful for mixing with low-grade poonac or other organic manures deficient in nitrogen.

Where rotation of crops is practicable, organic manures are best applied to the crops preceding rice, but if this is not possible it is advisable to apply them to the fields about a month before transplanting the rice, as if applied just previous to transplanting the products of decomposition may prove deterimental to the young plants.

The following leguminous plants have given good results as green manures in India: "daincha" (*Sesbania aculeata*), sunn-hemp (*Crotalaria juncea*), wild indigo (*Tephrosia purpurea*,) and green gram (*Phaseolus mungo*). Under favourable conditions daincha will grow to a height of 8 ft., and 1 acre will yield sufficient material to manure 4 acres of rice land. The other plants mentioned are of lower growth, and are best grown on the land and ploughed in. In Japan the most favoured green manures for rice are the soy bean (*Glycine hispida*) and "genge" (*Astragalus sinicus*). These and other leguminous plants add nitrogen to the soil, and on decomposition return to the soil the phosphoric acid and potash they had absorbed. Even more valuable as green manures are green leaves collected in forests or waste places, as they add phosphoric acid and potash to the soil, in addition to nitrogen and humus. The manures above mentioned are chiefly valuable for supplying nitrogen to the soil, but they may be rendered more effective by the addition of phosphatic manures. Of these the most suitable for rice are superphosphate and bone-meal, both of which give quick results in rice soils. It is seldom necessary to add potash manures to rice land, especially if the stubble or straw is burned on the soil or turned in when ploughing is done. Where soils are found to be actually deficient in potash, it may be added in the form of wood-ashes or potassium sulphate.

The kind of manure applied will naturally depend to a large extent on local circumstances as regards availability and cost of transport, and the peculiarities of the particular soil to be dealt with. As a guide to mixtures that have given good results when used experimentally, the following may be quoted: A leguminous green manure crop plus 112 lb. per acre of superphosphate; bone-meal 240 lb. plus saltpetre (nitrate of soda) 60 lb. per acre, fish manure 560 lb. per acre, plus sulphate of potash or wood ashes on soils deficient in potash; castor-oil cake 400 lb. per acre, either alone or with the addition of superphosphate; green leaves alone 4,000 lb. per. acre.—Imp. Inst. Bull.

ROTATION OF CROPS.

The main reason for growing a series of crops is, briefly, an economic one. It is well known that crops differ both in their food requirements and in their capacity to extract and utilise the various materials that make plant food. Leguminous crops, such as clover and beans, are largely independent of soil nitrogen, being capable of utilising the nitorgen of the air. Turnips depend largely on a ready supply of phosphates. Again, some crops (e. g., barley) are shallow rooted, and are consequently dependent on an available supply of food near the surface. Others, again (e.g., all tap-rooted plants), send their roots deep into the soil and draw their food supply from a comparatively extended area. Furthermore, some (e.g., wheat) occupy the ground for a longer period than others, and consequently have more time in which to enlarge their root system and reach the reserves of plant food in the soil. The potato crop, on the other hand, is comparatively short-lived; it is, moreover, a shallow but gross feeder, thus necessitating an ample store of food material near the surface. It will be readily understood, therefore, that a suitable alternation of crops is necessary to the economic utilisation of the resources of the soil.—Jour. of the Board. of Agric.

PADDY.

CULTIVATION IN CEYLON DURING THE XIXTH CENTURY.

E. ELLIOTT.

(*Continued from p. 100 Vol. XLII.*)

IMPORTED RICE.

Though somewhat foreign to the immediate subject of this compilation, the causes of the increase in the importation of rice into the Colony call for notice, as this has been advanced in the Ceylon Press as evidence of "no special advance in local production" and in the London Times (29th Sept. 1913) "surprise was expressed that in the face of a 10% protection duty the quantity of rice imported into Ceylon had increased from 5 to 12 millions of bushels between 1872 and 1911."

Not only are such assertions and suggestions entirely erroneous, but they further ignore the true reasons for the increase in the importations. For firstly, as already shown, the island production has doubled in the past fifty years and increased by 33% since 1891, and secondly the additional demand for foreign rice is due to the increasing number of the alien immigrant element in the population, and the continuous advance in extent of the plantations with their connected interests, on which such labour is employed. Indeed as a matter of fact the addition to the imports of rice *has not kept pace* with the development in these respects, as the following tabular statement discloses:

Rice Imports, Bushels*	1871	1881	1891	1901	1911	Increase. 1871-1911
	4,259,000	6,031,000	7,162,000	8,951,000	11,856,000	177%
Plantations, acres	185,000	310,000	341,000	460,000	640,000	246%
Estate Population, persons	131,000	211,000	262,000	442,000	513,000	291%
Indians.	232,000	322,000	312,000	490,000	530,000	128%

Of the Aliens according to the Census returns the Indian born were in round thousands 193 in 1871, 277 in 1881, 265 in 1891, 437 in 1901 to 71 in 1911. In addition there has been an increasing number of Ceylon born descendants of Indians who have settled in Ceylon, and who were for the first time separately enumerated in 1911 and found to be 59,000.† For the previous periods I have worked back approximations at about 1% as the net

* Ferguson's Directory figures. Census figures.

† I am doubtful of this figure: 530,098 given in the Census report includes 32,274 Indian born Moors found in Ceylon in 1911. If it does not the Ceylon born "Indian Tamils" should be raised to 91,000, but to be on the safe side I rest my case in the lower figures. The increase in the number of I. B. Moors residing in Ceylon has not been publicly noticed, having risen from 17,011 in 1881 to 24,250 in 91 and 32,724 in 1911.

yearly difference, which gives 39,000 in 1871. It must be remembered in consequence of the supply of Indians not keeping pace with the increased area of the plantations (exclusive of coconuts) a large number of Sinhalese villagers are now employed, especially in the low-country, who return to their own homes at night and are consequently not included in the return of "estate population," but supplement their local food supply with *imported* rice, thanks to the additional wages thus earned.

As the figures are somewhat more reliable since 1891, when a fresh era of prosperity set in, it is gratifying to find they strengthen the view expressed above—the importation of rice having only increased 65% as against 134 in estate population, 87 in acreage of plantations (exclusive of coconuts) and 70 in Indians, during the 20 years ending in 1911.

Further comparison of the figures discloses that the Alien element in the population is the dominant factor governing the importation of rice, and that any excess of arrivals of immigrants over departures in any year has been inevitably accompanied by a rise, and by a decrease where the reverse is the case.

Thus, between 1871 and 1878, the *excess* of *arrivals* was 140,000 owing largely to famine and scarcity in India and the imports rose from 4·38 to 6·93 million bushels.

On the other hand between 1879 and 1886 the *departures exceeded* the arrivals by over 86,000, and the importation of rice fell to 5·4 million bushels.

Between 1887-90 the *arrivals* were again 42,000 in *excess* and the rice rose to 6·5 million bushels.

Since that the fluctuations have been as under:

Year.	Excess in 000.	Imports	Year.	Excess in 000.	Imports.
1890		6·5 M.B.	1903	15·	8·5 M.B.
1891	43·	7·6 ,,	1905	107	10·2 ,,
1895	43·	8·7 ,,	1906	65·	10·7 ,,
1898	31·	9· ,,	1908	80	10·1 ,,
1900*	95·	9·6 ,, (*)	1910	54	11·8 ,,
Total ...	212			249	
Rise in Rice ...	...	3,000,000 Bushels	...	...	3,300,000

But there are others besides the "Indians" who *solely* eat imported rice, viz: (*a*) The inhabitants of Colombo (when the development of the Port and the extension of trade have nearly doubled the population since 1881) also the residents of the towns of Kandy and Galle.

(*b*) The low-country Sinhalese attracted to the Central Province and Kegalle by the great development of planting.

* In 1901 when the excess was only 2000 the importation fell to 8·5 m.b.

(*c*) The Moors, Malays, and others resident in the same provinces but exclusive of Sabaragamuwa and Kurunegala. (Of the former class there is no return available as the Census report only shews the number born in the low-country but resident at the time in this province. I have adopted these figures as sufficiently accurate for the purpose in view though really under the mark owing to the omission of the descendants of such settlers, born up-country).

As the persons in these classes are more or less prosperous and many draw good wages and are largely able-bodied males, whose requirements are generally a bushel a month, I put their average consumption at 7 bushels of rice per annum. The numbers of these classes who entirely use imported rice and the consumption by them and the Indian Tamils are as follows:—

	1891	1901	1911		
Colombo	103	120	164	000	persons.
Kandy	21	23·4	27	,,	,,
Galle	34	36·6	39·4	,,	,,
Low-country Sinhalese.*	24	36	48	,,	,,
Malays and others†	8	9·6	10	,,	,,
	190	225·6	288·4	,,	,,
Indians	313	4900	530·4	,,	,,
Total	503	715·6	818·4	,,	,,
Total Rice Import	7,162	8,951	11,856	000	bushels.
Consumption by above‡	3,731	5,289	6,044	,,	,,
Balance	3,431	3,662	5,812	,,	,,

The balance of imported rice shown above is consumed by the rural population who supplement these with the local food supply, especially the villagers employed on the estates in the low-country, largely in Kalutara and Galle, by day only, and consequently not included in the returns of "estate population" already taken into calculation.

In Jaffna too a good deal of imported rice is consumed in addition to the local supply and the surplus received from Batticaloa. Of the numbers of such consumers there is no return, and no reliable estimates are practicable; so further investigation must proceed on the presumption that the balance available for distribution is consumed by the balance of the population, after excluding the "whole eaters" already taken into the account.

*Resident in Central Province, Uva and Kegalle.

†Excluding Tamils.

‡At 7 Bushels per annum per head.

To judge how far this is affected by local production I have framed the following statement :—

	1891	1901	1911	
Total Population ...	3,000	3,560	4.110	000 persons
Deduct exclusive eaters	533	755	863	,, ,,
Partial consumers ...	2,467	2,805	3,247	,, ,,
Balance imported rice...	3,431	3,662	5,812	,, bushels
Consumption per head...	1·39	1·03	1·79	bushel
Ceylon production rice	4,507	5.778	5,110	000 bushels
,, ,, per head...	1·82	2·06	1·57	bushel
Total consumption per annum per head ...	3·21	3·36	3·36	

It is significant that the average consumption of imported rice by the rural population fell to 1·3 b. per head in 1901, when there was a good crop in Ceylon, especially in the Western Province* and Jaffna district ; and that it was highest (1·57 b. or 20 % additional) when the production in those districts was deficient, the *combined* annual consumption being very much the same about $3\frac{1}{3}$ bushels per head.

There is no probability of the reduction in the Western or Central Province being largely added to, and as the cultivation is almost entirely dependent on the rainfall, there will be fluctuations in the crops, but thanks to irrigation in Kurunegala, Anuradhapura, Mannar, Batticaloa and Tissamaharama, there will be a supply considerably in excess of local requirements, wanting cheaper transport to suitable markets, especially those of the Western Province than is now available.

The Batticaloa excess doubtless reaches Jaffna to which freight is moderate, and the price is high, being governed by the selling rate for imported rice. Owing to the absence of such facilities may I think be ascribed the increase in the consumption of the foreign article in to 1·4 b. per head (an advance of 10 %) in 1893, when the largest crop ever harvested in Ceylon nearly 7 million b. rice and giving a supply of 2·36 b per head of the rural population) but the heaviest production was in Kurunegala, Anuradhapura and Batticaloa, while the W. P. crop was again moderate.

I note that in 1907, 403 tons of rice (say 30,000 b. of paddy) were sent away from the Maho station in Kurunegala district in spite of the high railway charges.

Such transfers should, of course, be encouraged and made possible for longer distances by a considerable reduction in the railway fare *for paddy*, it being the form the villager prefers to purchase his rice, the conversion being done by the females of his household free of cost.

To trace the distribution in 1911 of the balance of imported rice left after providing for the alien element and other "entire consumers" as already

*Note.—The W. P. Crops in 1901 was equivalent to 1,912,000 as against in 1911 of 703,000 bushels rice.

estimated, I have prepared the following statement of the approximate requirements of the rural population of each district and how far they are met by local and foreign grain respectively.

Province or District.	Population persons.	Requirement per head.	Aggregate requirement.	Local supply.*	Imported supply.
	000	Bushels.	000	Bushels.	Rice.
Western †	880	$3\frac{3}{4}$	3,400	628	2,772
Central †	285	$3\frac{1}{2}$	997	735	262
Galle and Matara †	485	$3\frac{1}{4}$	1,576	564	1,012
Uva	138	$3\frac{1}{8}$	431	250	181
North-western	403	3	1,209	764	445
Sabaragamuwa and Kegalle	320	3	960	630	330
Northern	360	3	1,080	378	702
Hambantota	110	$2\frac{3}{4}$	308	202	106
Eastern	183	—	583	583	—
North-central	83	—	374	374	—
Unaccounted for	—	—	4	2	2
	3,247	326	10,922	5,110	5,812
Indians and others ‡	863	7	6,044	—	6,044
Total ...	4,110	—	16,966	5,110	11,859

In the Batticaloa and Anuradhapura districts where no imported rice is consumed by the villagers and the people are now well off for food, the average crops supply $3\frac{1}{2}$ bushels rice per head. This I have taken as the average basis of rural requirements, raising it in the case of the Western Province slightly in view of the opportunities existing therein of earning additional wages, and the consequently higher standard of comfort and luxury. On the other hand I have made a reduction to an average of three in districts where a portion of the inhabitants have not such opportunities of adding to their resources, and have to be content with the local supply and when this is limited to go without. This is specially the case in Hambantota district where imported rice is only used about Tangalle and by preference by the poor Malays in the town itself.

*At 2 bushels paddy for one of rice.

†Exclusive of Colombo, Kandy and Galle Town Population and Indians.

‡Who exclusively use imported rice.

FRUIT.

THE CULTIVATION OF CITRUS IN THE PHILIPPINES.

Mr. P. J. Wester, Horticulturist in charge of Lamao Experiment Station, has written an interesting bulletin on citriculture from which we take the following extract :—

The following advantages are derived from budding or grafting :

1. A stock best adapted to the soil and climatic conditions can be used and by this means citrus fruits can frequently be grown in sections where this would be impossible if they depended upon their own root system.

2. Any variety desired can be grown in any quantity desired.

3. By planting budded trees the uniformity of quality and appearance of the fruit is insured, which is highly important in a discriminating export trade.

4. Budded trees are more precocious than seedlings, less spiny, and do not grow so tall ; they therefore (a) yield a profit earlier than the seedlings ; (b) the gathering of the fruit is performed with more facility ; (c) if insect pests and diseases gain entrance into the orchard their control and eradication is more easily effected in low-headed than in tall trees ; (d) they are not so liable to injury by storms ; and (e) by shading a larger area of ground they assist in conserving better the moisture in the earth during the dry season.

5. The season of maturity can be controlled to a large extent by the planting of early or late fruiting varieties.

6. Finally, even with the greatest care in seed selection, seedlings will always vary in productiveness.

Many people are under the impression that a budded tree must of necessity be superior to a seedling irrespective of where the bud came from, as if the budding process had effected some magical transformation in the plant ; nothing can be more erroneous, however. *Budded trees produce fruit identical with that of the trees from which the buds were obtained* except in so far as it may be very slightly influenced by a different stock and a different environment. The process of budding itself is not an improvement, but the *means by which the betterment is effected in the grove.* Therefore, in order to be an improvement upon this seedling, the bud *must be procured from a tree bearing superior fruit.*

STOCK.

Horticulturally speaking, the "stock" is a seedling upon which is budded or grafted another variety of the same or another species ; sometimes a plant belonging to one genus can be grafted upon one of another genus. Contrary to the general public opinion, the stock has a greater or less influence upon the scion or the budded part of the tree, and vice versa, while the climate also is a determining factor with regard to flavour and quality.

Therefore, it is not possible to guarantee the behaviour of any imported variety until it has been actually tested. A most striking example of this fact is the Bahia, or Washington navel orange, which has made California famous as an orange-producing country. In Florida, while it grows well, and produces a thin-skinned, well-flavoured fruit, this variety is so unproductive that it cannot be grown profitably there and the quality of the fruit itself differs greatly from that grown in California. In California the Bahia is highly coloured, thick-skinned, and rather acid. In October, 1912, the author had an opportunity to sample a fruit of the first Bahia orange grown in Manila, and while retaining its size, seedlessness and the navel characteristics, the skin of the fruit was very thin and "silky" and the flesh rather too sweet. Without knowing the facts no one would have ventured to state that it was the ordinary Bahia.

In Florida, California, the Mediterranean countries, and Australia, the sour and sweet orange, pomelo, rough lemon, trifoliate orange, and the lime are used as stocks. In the Philippines we may, in addition to those enumerated above (excepting the trifoliate orange which is unsuited to conditions here), use the mandarin, cabuyao, calamondin, and taboc, *Aegle glutinosa* Merr.; furthermore our choice is not limited to these, regarding them as entities, for the Philippines have a large number of very distinct citrus types belonging to these species, many of which are, as previously stated, evidently natural hybrids and should perhaps *be regarded as sub-species.* From the great range of variation among these types it is evident that their influence on the stock must likewise vary for better or worse.

Generally speaking, the sweet orange, sour orange, pomelo, and lime can be recommended as stocks in the Philippines within the limitations set forth in the discussion of these species, without fear that they will adversely affect the quality of the fruit.

The qualities that determine the value of a certain stock are vigour, resistance to certain diseases, its influence on the scion with respect to productivity and quality of the fruit produced, and also to some extent its influence with respect to the habit of the top.

As far as the writer is aware only one test orchard has ever been planted on any considerable scale with the object of determining the value of a certain stock for a certain variety of citrus, and this test was limited to two stocks only, the trifoliate orange and the sour orange. The influence of the stocks upon the scions was here, as in other instances where this has been noted, very marked, and considerable variance has been likewise observed in many other instances, both as regards the growth and productiveness; from the accumulated evidence it is reasonable to believe that all cultivated varieties are more or less susceptible to stock influence.

For the reasons stated above and in order to prevent losses later it is highly important that now, in the initial stage of the establishment of the citrus industry in the Philippines, as complete a stock and variety test as possible be made in the various districts of the Archipelago where it may seem desirable to establish a citrus industry.

Photo by H. F. Macmillan

A PROLIFIC CACAO TREE

(Nicaragua Creole variety) on Experiment Station, Peradeniya

In order that some light may be thrown on this important subject the Bureau of Agriculture has begun an extensive stock and variety test at the Lamao experiment station, and this will be extended to the provinces as rapidly as the funds of the Bureau permit.

The sweet orange was exclusively used as a stock in all citrus-growing countries until mal-di-goma appeared in Italy and Florida, since which time its use has been almost entirely discontinued in these countries because of its susceptibility to this disease. It is still extensively used as a stock in California and Australia. The sweet orange should never be used as a stock on low, moist or poorly drained lands, but rather on well drained, light soils, where trees budded to this stock make a satisfactory growth and develop a shapely symmetrical top. The sweet orange has a well-developed root system and in rapidity of growth it is surpassed only by the pomelo, the rough lemon, and the cabuyao.

The pomelo is one of the most vigorous species in the genus and is in this respect surpassed by none save certain forms of the cabuyao. Judging from the experience in other citrus-growing countries the pomelo is unrivalled as a stock on dry soils and it succeeds well in those with an intermediate degree of moisture content. The root system of the pomelo is well developed and as far as known it is exempt from mal-di-goma. In south-west Florida the pomelo has won favour as a stock in preference to other species and is to some extent replacing the orange as a stock in California.

The mandarin is not so vigorous as the species already discussed, but considering that the mandarin seedling orchards in the Philippines have been so successful during the past it is believed that this species is well worthy of trial as a stock, as well as the other species of the genus.

The ordinary lime is used as a stock to a slight extent in south east Florida on stony, calcareous soil; the fruit produced on this stock—oranges, mandarins, and pomelos—is of excellent quality. The root system of the lime is weaker than that of any of its congeners heretofore mentioned and the tree is less vigorous and not so long-lived.

In some parts of India the so-called "sweet lime," a variety of vigorous growth bearing large, watery, sweetish, insipid fruits, is commonly used and considered a satisfactory stock for the mandarin and the orange.

The sour orange, *Citrus vulgaris* Risso, and the rough lemon, are used to a great extent in Florida as stocks and have recently been introduced by the Bureau of Agriculture. Both of these are resistant to the mal-di-goma. The sour orange is better adapted to moist though well-drained lands of moderate fertility, while the rough lemon is recommended for dry poor soils. The rough lemon has a tendency to increase the size of the fruit and its acidity, is comparatively shortlived, and is in south-east Florida being gradually replaced by the sour orange. It is very doubtful if this stock rough lemon would be of much value in the rich soils of the Philippines.

Of late years several citrus fruits have been worked successfully upon the taboc, *Aegle glutinosa* Merr., which is considered very drought resistant, and while this as well as related species may prove desirable stocks for the citrus fruits their value for practical purposes is still problematical and as yet their use on a large scale cannot be recommended.

BANANA CULTIVATION.

O. W. BARRETT.

The banana leaf, being very easily damaged by strong winds, must be sheltered as much as possible, and therefore either hills or belts of trees should be in evidence to protect banana plantations from prevailing winds. In large plantations cross belts of leguminous trees should be planted at least every 100 meters. Alluvial areas along streams are to be preferred although narrow valleys and bases of hill slopes may be used providing the soil is not too rocky nor clayey and the exposure to winds not too great.

SOIL.

While there are some individual variety preferences among the bananas and plantains, practically all kinds will grow in ordinary soil, even nearly pure clay or sand (if not too coarse) sometimes giving fairly good results. Sedimentary soils and flooded plains usually give the best results, however, providing there is sufficient drainage to prevent stagnation of water for more than two or three days at a time during the rainy season.

The banana root being rather tender, it is unable to penetrate "hardpan," and is not likely to do well in very rocky or gravelly soil; on the other hand, the root system is vigorous and the feeding roots extend to a distance from the base of the stem equal, approximately, to the height of the plant.

The banana will endure almost any amount of rain providing the drainage is good but any prolonged drought is very likely to check the growth if not stunt the entire "pono," or clump. Cracking of the soil during prolonged dry weather not only allows the slight amount of moisture to evaporate rapidly therefrom but breaks many of the feeding roots of the plant.

SELECTION OF SEED SUCKERS.

While it is theoretically possible to use the base of any banana stem or even a portion of this for planting, much better results are obtained by using the suckers produced about the old plant. These offsets, ratoons, or as they are commonly called, suckers, may be divided into three types: Root buds, or the comparatively small short offsets having only a short growing point at the tip; the common ratoon which may have one or two rather broad leaves at the top of a stem from $\frac{1}{2}$ to $1\frac{1}{2}$ meters high; and, best of all, the "sword" sucker, which has a strong large base gradually tapering to a slender point with one or two very narrow straplike leaves at the tip which may be one meter above the surface of the soil.

These suckers should, of course, be selected from the most vigorous plants and in no case should they be taken from the vicinity of a "pono" which appears to be diseased or infested with the root-weevil. The suckers should be planted as soon after taking up as possible, although if necessary they may be kept for several weeks. For long-distance transportation the tops may be cut off, leaving only 10 to 20 centimeters of the stem above the bulb; the cut-back suckers should be thoroughly dried and packed in ventilated boxes or sacks for shipping. If badly cut by careless workmen in digging, the suckers should be "healed over" by drying for a few days before planting.

PLANTING.

The holes should be dug a week, or better a month, before setting out the suckers; they should be not less than 40 centimeters deep and better 50 or 60 centimeters in most soils. The diameter may be from 50 to 75 centimeters in most soils. The diameter may be from 50-75 centimeters depending upon the size of the sucker and the character of the soil. The hole should be levelled, if the ground is slightly sloping, i.e., earth from the upper should be heaped upon the lower side to form a sort of table and thus prevent "washing" during heavy rains.

The holes should be not less than 3 nor more than 5 meters apart. For most varieties, 4 meters will be found the most economical distance, especially if the plants are to be left in position for three or more years.

The suckers should be set so that the top of the bulb is at least 10 and better 15 centimeters below the soil surface, except in the case of root buds, which should be set so that the tip comes just to the surface. The sucker should, of course, be set vertical, but if halves or entire stem bases of old plants are to be used, particularly in the rainy season, these should be laid on the side in order that surplus water may not fill up the spongy tissue of the stem-base and cause rapid decay.

In refilling, earth from the soil around the surface hole should be used, the earth from the bottom being left outside on the lower side of the hole. The earth should not be packed too hard over the base of the young sucker but should be pressed just enough to hold the shoot firm until roots have formed. Loose earth may be heaped up somewhat over the top of the hole to allow for the "settling" of the earth after planting.

CULTIVATION.

Immediately after setting out the suckers they should be mulched with straw, leaves, or brush to prevent the sun from heating and drying out the soil about the young plants, especially in the dry season; or, if planted in the rainy season, cowpeas or some sort of beans or leguminous vines should be planted rather close about the young plant in order to provide a blanket crop to keep down the growth of cogon and weeds and thus save expenses in weeding and hoeing. During the first year after planting, catch crops, such as sweet potatoes, pine-apples, maize, or upland rice may be planted between the rows of bananas, provided a clear space of at least 1 meter radius is left around each banana. If no catch crop is planted between the banana rows there should be some sort of a cover crop in evidence to keep down the growth of weeds and grass.

HARVEST.

The first bunch of fruits should be mature in about twelve months from planting; some varieties require only ten, while some of the larger or more delicate of the plantains may require eighteen months even with good soil conditions. The time for cutting the bunch must be learned by experience. Most varieties are cut for market while the fruit is still green though, of course, for home use it should ripen on the plant. A rounding of the angles (possessed by nearly all varieties) of the individual fruits indicates that the growth of the fruit is practically complete; as soon as this plumpness of the fruits in the bunch is well marked it may be cut for market, the ripening taking place subsequently either *en route* or in the store room at the market end.

At the time of cuttting down the bunch the stem producing it should be felled and chopped into three to five sections which should be placed about the "pono." The custom of allowing the stem which has produced a bunch to remain standing after the harvest is not to be recommended, since in that way certain fungus or bacterial diseases may develop and spread to living stems; the quicker the decay of the spent stem can be accomplished the less the danger from these fungus diseases; contrary to common belief, the sap in the old stem does not feed the daughter shoots.

If the "pono," or clump, has been growing well there will be at the time of cutting the first bunch two or three younger stems nearly ready to fruit; if there are more than four or five, one or two of them should be cut out in order that the strength of the "pono" may not be exhausted in producing too many (probably small) bunches at the same time. Only the experienced planter will know just how much to reduce the number of main stems in the "pono" and how many small suckers to leave for future fruiting stems; the age of the "pono" question, of course, makes considerable difference in this matter. In rich soil the life of the "pono" may be four or even six years, whereas in poor soil the planter may be obliged to replant every two or three years.

PACKING AND SHIPPING.

For shipping short distances the fruit bunches need little or no wrapping, especially if they have been cut quite green; for greater distances dry banana leaves, straw, or similar materials should be used for wrapping the bunches to prevent bruising and breaking *en route*. The more valuable dessert varieties may be cut into "hands" and packed in crates or baskets with padding material between the layers of hands. Fruits of the very small varieties may be nearly ripened on the bunch then cut so that each fruit has a small portion of the main peduncle attached to its own base, and then put into small cartons for retail trade.

FERTILIZERS.

Except in worn-out soils near towns fertilizers are seldom to be recommended. There is no doubt but that ordinary chemical fertilizers containing potash and phosphoric acid with or without nitrates will stimulate growth and productiveness, but the expense for fertilizers unless very carefully applied by an experienced planter will hardly balance the gain in product. If some sort of leguminous cover crop is maintained between the rows and if no grass-root excretions have been allowed to poison the feeding roots of the bananas, the fertility of the soil should be a matter for little worry on the part of the planter.

A compost pit in which all vegetable rubbish, animal manures, etc., can be quickly rotted is unquestionably a valuable feature for a banana plantation. No fresh animal manures should be used directly upon the young plants.

If the soil in the plantation becomes so exhausted after, say, five years that the crops are reduced below the paying point the planter should change the crop; i.e., he should cut down all the bananas and either dig up the roots or else allow some strong-growing cover crop, like Lyon beans, to smother them. After "resting" the land for one or two years in a legume crop he may replant the areas with maize, yams, sweet potatoes, upland rice, vegetables etc., and then replant with bananas.

YIELD.

If the "ponos" are set 4 meters apart there should be 625 per hectare. Each "pono" should give one bunch of fruit at the end of the first year, if good methods have been followed; the 600 bunches should be worth some 300, wholesale. The second year the yield should be considerably greater, say, 400 to 500 in value. The value of the third and fourth year's crops depends very largely upon the kind of soil, the weather, and the planter.—Philippine Agricultural Review.

SIAMESE POMELOS.

H. H. BOYLE.

On September 13 the writer proceeded to the Nakoi Chisii district where the finest pomelo orchards are located. The largest of these was owned by a Chinese planter and contained about 20 hectares, three-fourths of which was planted with pomelos of the "seed" variety, while some 25 per cent. of the area contained "seedless" trees. The orchard is divided into plats some 7 meters wide by 60 to 90 meters long, separated by trenches some 3 to 4 meters wide by 2½ meters deep. The pomelo trees are planted in single rows on these plats. All trees are propagated by marcottage, or the "don" method. The writer was able to demonstrate the modern methods of buddage and through the assistance of *Koon Pisit* explained each step so that, were it not for the deeply inculcated custom in vogue there, the planters would now be able to propagate their trees much more rapidly and economically. The soil of this orchard contains about 60 per cent. clay.

The first fruits examined in the "seedless" section proved to be full of seeds. Upon inquiry as to the reason for this it was stated that the seedlessness was due to the salt deposited from the brackish water which backs up into the river during the dry season; the planters also said that a coconut shell of salt was placed in the hole at the time of transplanting the tree and that another shellful was given the tree each year. Being unable to give full credence to these stories the writer began a thorough investigation of the trees in the "seedless" section, cutting open fruits from widely separated points on each tree and gradually arrived at what is believed to be the true explanation of this phenomenon: all, or nearly all, trees in the so called "seedless" section are the genuine seedless type and are not self-fertile; i.e., in order to produce seeds the flower must be pollinated with pollen from the "seed" trees in the near vicinity. In some striking cases the fruits on a "seedless" tree were found to be free from seeds on all branches of the tree except those on the side nearest to a "seed" tree, the pollen from the latter having apparently been carried across by insects or borne by the wind to the "seedless" flowers.—Philippine Agricultural Review.

PINE-APPLES IN FORMOSA.

Pine-apple growing in Formosa is developing rapidly. The Hozan Pine-apple Cannery Company has put up 360,000 cans in the season which has just ended; this is about double the previous season's output; the Company has consequently declared an 8 per cent. dividend.—Philippine Agricultural Review.

BANANA CULTIVATION IN JAMAICA.

WHAT AND HOW TO PLANT.

The cultivation banana of commerce has long ago lost the habit of making seed as it is supposed to be the oldest cultivated, or at least, domesticated plant. It is grown from "a sucker" or "head" as banana planters call it, and a "sucker" or "head" is the bulb root of a banana, which may be compared to a gigantic onion. When suckers or heads are wanted for planting they are usually taken from an old field or one about to be thrown up for replanting, where there are many suckers to choose from. Young plants are taken at an age of 6 to 8 months when they are about 9 to 10 feet high. These are called "Maiden Suckers." They are dug out, and all the trunk part cut off a foot or so from the bulb. Some planters cut the stem close up to the bulb, and this is done when the suckers have to be transported from a distance to lessen freight. But taking suckers from one's own field or near by, it is better to leave a foot of the stem which in the event of dry weather ensuing after planting, can drain its moisture into the bulb. Bulb-roots from younger plants can be taken but they do not contain so much food material, so have not the growing power that more mature bulbs have. Again, older plants than 8 or 9 months may not be taken, as after that age the bunch is about to shoot and from then on, part of the strength is out of the bulb. Old plants from which the bunch has been cut are unsuitable for planting; the vitality is out of them. Such a sucker is called "a spent" sucker. A common error is when digging the bulb to cut too close to the stem, as much of the bulb as possible should be taken.

The old way of planting was to cut a young plant 6 or 8 feet high, the offshoot from an older one, and plant it upright, leaves and all. By this method, however, it was top heavy and easily blown over by the wind; and moreover before the bulb could make new roots, the leaves and stems dried up more or less. Unless in very rich soil such a plant cannot give a good bunch for the first, but the ratoons or following growths having had time to make a good root system will be all right. A later method was to take a sucker at a young stage, an offshoot from a full grown plant called a "sword" sucker, taken before the leaves opened out and plant this. Such a young plant was cut off from the old root with as much bulb as possible. These suckers were planted upright but they took long to grow, and seldom gave good bunches unless on very fertile soil, as, however, the land generally was, when banana growing first was begun here. They had not enough vitality stored in their small bulbs to enable them to grow quickly. Such suckers are still planted, however, under certain circumstances, such as to supply a field where a plant has failed, for then the growth from a bulb sucker would be overshaded by the plants already growing, and be stunted, whereas a tall sword sucker would be of equal height and share equally in the sunshine and air; also this makes the field look more even in growth.

It was later discovered that by taking plants when they were nearly fully matured with all the food material stored up in the bulb ready to make the bunch, the maximum vigour was obtained. At first these cut bulbs were planted upright with a foot or so of the stem above the soil, and in a day or

two a new growth would start out from the cut surface. When soils were very rich this way of planting gave fairly good bunches but later the results became poor. It was then found that though by this method the new shoot starting from the heart (where the old one was cut) grew quickly at first as the shoot drew upon the food stored in the bulb, yet as this growth was made before the roots were formed, the food was used up, the plant received a check as it had then to wait until roots were formed and could send up food from the soil; these roots too were slower to form because the new plant was consuming the food material stored in the bulb which should first have gone to make roots. After experimenting it was found that better results in bunches were obtained by planting this bulb or sucker flat or sideways in the holes to allow a new plant to start from one of the eyes. There are several buds or eyes on a large bulb and some planters take all of these off but two when planting; otherwise many shoots start out and when they appear above the soil have to be cut except the largest and strongest. When two eyes are left it still gives a choice of two when both grow, and in case of accident to one, the other is left. Others plant the "heads" as they are, and prune out the other growths when they appear above the ground leaving one or two of the strongest.

The principle of this system of planting the bulbs is scientifically correct. The bulb root contains stored up food, largely starch. As with a seed germinating, the heat and moisture below the earth, change the starch into sugar, roots grow at once, and before the new shoot can appear above ground there is a root system able to supply foodstuff to the young plant, which until it gets above ground is living on the sugar food in the bulb. The plant thus receives no check.

In a large sucker there are obviously larger supplies of food, to make powerful roots and send forth a vigorous shoot as a new plant, than in a small bulb.

If the soil around is soft and moist, and rich, the roots spread far and wide and deep, although the banana plant is not a very deep feeder. If the soil is hard or lumpy, or dry, or poor with a hard sub-soil, the growth must evidently be slower, and if this poor feeding ground continues, the plant gets stunted and cannot make a good bunch.

The young banana plants ought to grow rapidly and in 9 or 10 months from planting, shoot their bunch under normal circumstances, and the bunch takes under ordinary condition three months to be full for cutting for shipping, full but still green. If planted thickly or allowed to grow thickly they do not get enough light and air, take longer to shoot and the bunch takes longer to fill up. The cooler the temperature the slower they are to grow so that as one goes out of the plains to the hills, the growth is slower and the bunch takes longer to fill. But this is not remarkable up to 1,000 feet and at 2,000 feet the difference from sea level is on an average 3 months, at 2,500 to 3,000 feet 6 months, soil seasons and cultivation being equally good to make other comparisons even. It should be borne in mind that in the hills the days are quite as hot as in the lowlands, and plants do not grow appreciably at night; but the heat of the day does not last so long as one gets higher up so there is less growing time.—Jamaica Agric. Journal.

CITRUS MEDICA.

The different varieties of citrus medica are so frequently confused by old writers that it is sometimes difficult to be sure which they are speaking of. Medica in this connection does not refer to medicine, but to Media, where the citron (of various kinds) is said to have been established early in our era, though the eastern end of the Himalayas is believed to be its native habitat. The citron itself was the first of its genus to be known in the West, and the orange and lemon were not introduced into Europe until the twelfth or thirteenth century. The lime, now so largely cultivated for our use, is not mentioned under that name by any writer I know before 1638, when Sir Thomas Herbert speaks of having found "Orenges, Lemons, Lymes" in the island of Mohelia (in the Comore group of Mozambique), in his voyage begun in 1626. A later traveller, Dampier (1697), says: "The lime is a sort of bastard crab-limon. The tree or bush that bears it is prickly, like a thorn, growing full of small boughs;" a description which recalls an earlier account of the lemon-tree—that of Fitch in his narrative of Captain Keeling's voyage to Sierra Leone: "The limon-tree much resembles the crab in several points, is very full of prickles, and carries a slender leaf like a willow." He speaks of a "vast wood" of it on the coast. One of the varieties of *Citrus*, the *Pomum assyrium* of some old writers, was held, says Gerard, by "the common rude" people of Italy to be "the same apple which Adam did eat in Paradise, when he transgressed God's commandment; whereupon also the prints of the biting appear therein, as they say."—Chemist and Druggist.

ECONOMIC VALUE OF THE BAT.

According to the Review of Applied Entomology—Series B: Medical and Veterinary, for October 1913, bats are probably immune from the bite of a mosquito, firstly because of the peculiar formation of the hair covering their bodies and secondly because of their peculiar odour. Bats in general are remarkably free from disease, and this is shown by the fact that although they live in caves in vast numbers, touching one another and even hanging to one another, yet men engaged in collecting bat guano very rarely find a single animal dead.

In Texas experiments have been made with the object of cultivating bats for the production of guano, and at the same time for the control of mosquitoes. It has been found that a structure large enough to hold 50,000 bats would cost considerably less than £2,400 and that would yield in a year 20¼ tons of guano on an average value of £121. 10*s*. During the experiments, enquiries made in this district, of the heads of fourteen families, showed that the number of mosquitoes had abated remarkably, and that the fever which was previously rampant had almost entirely vanished. It is therefore concluded that it is not only commercially, but hygienically profitable, to cultivate bats.—Agricultural News.

DRY-FARMING.

"Privileges, like rights, connote duties, and the duty that I should wish every boy in this hall to know, a duty imposed upon him by the privileges he has received here, that duty is this, that he should go forth into the world remembering his privileges, anxious by his counsel, and superior knowledge and sympathy, to help those whose lot has been unfortunate, and who have not been able to enjoy the same privileges he had enjoyed. In particular, and this is the last word, I would exhort those who in the time to come may pass away from this school, to use the education they have received here,—it may be to conduct family estates or to engage in agriculture or other developments of the Island's resources. I would exhort them, by their knowledge, by their aid, and by their sympathies, to do what they can to help on the cultivator, whose lot has not been so easy as of the boys who have received their education here. I would ask those who are embarking on agricultural pursuits, to do their best to bring what is known as the squire-clerk to the aid of the Government to achieve the advancement of the Colony."
— *Address of* Sir Robert Chalmers *at the Prize Distribution at the Royal College.*

As an old boy of the Academy, I am responding to this clear call to duty. I am doing this, more especially as a very prominent official has indulged in very pessimistic opinions as regards the possibilities of Dry-farming, and it becomes my duty as its sponsor in this Island to do my little best to counteract any ill-effects they are likely to cause.

I will quote from Widstoe's preface a few lines as also some extracts which will meet most of the obstacles that have been raised. "The possibilities of Dry-farming are stupendous. In the conquest of the non-irrigated and non-irrigable desert are offered as fine opportunities as the world has known to the makers of Empires. We stand before an undiscovered land through the restless ascending current of heated desert air the vision comes and goes. With stirring eyes the desert is seen covered with blossoming fields, with churches and houses and schools, and in the distance, with the vision, is heard the laughter of happy children."

The desert is conquered.

A fine specimen of the picturesque phrases with which we are told by Mr. Freeman that the face of nature cannot be altered as also the conditions of life.

The designation of the Wanni as "desert" is taken exception to; the contradiction is too trivial to be noticed. The Wanni though arid is said to be malarial. It will be, as long as it is covered over with vegetation. It is common knowledge in Ceylon at the present time that malaria is caused by the breeding of "Anopheles" in stagnant water. In regions where Dry-farming is practised, there will not be super-abundant moisture to stagnate, and as a consequence there will be no mosquitoes and malaria.

On the discussion of my paper on Dry-farming, the Hon. Mr. Freeman was under the erroneous impression that it was the same as *chenaing*. In his letter to the December number of the Tropical Agriculturist, his

knowledge of the subject does not seem to have increased. He states that the Jaffna man is a "ready-made dry-farmer and understands and practises tilth, the essence of dry-farming." There is hardly any "farmer" who irrigates his dry-land crop more than the Jaffna man. He is at it from early morn till dewy eve, except during the hottest hours of the day. "Dry-farming, as at present understood, is the profitable production of useful crops *without irrigation* (the italics are mine). The Iranamaduwa or any other land will not be wanted for Dry-farming."

The removal of the roots of big trees it is said will be an obstacle to Dry-farming. Recently, demonstrations were made of the use of Dynamite for removing tree-stumps. In other countries, stumps are removed by mechanical means. There is a mechanical contrivance called the Hercules' Stump Puller. It is said to be capable of pulling out a 4 ft. diameter stump in three minutes. At each setting it is said to be able to clear two to three acres. That is, by animal power. There is also a hand-puller. Besides, there are ploughs that can "jump" stumps and stones.

It has been stated that paddy will not be suitable for a Dry-farm crop. It was therefore suggested that hill paddy or "Ell-vi" should be grown. "The choice of the crop, its proper seeding, and its correct care and harvesting are as important as rational soil treatment in the successful pursuit of Dry-farming. Plants possess a marvellous power of adaptation to environment and this becomes stronger as successive generations of plants are grown under the given conditions. Home-grown seeds, if grown properly, are therefore of the highest value. Wheat is the leading dry-farm crop. Every prospect indicates that it will retain its pre-eminence. Not only is it the most generally used serial, but the world is rapidly learning to depend more and more upon the Dry-farming areas of the world for wheat production. In the arid and semi-arid regions, it is now a commonly accepted doctrine that upon the expensive irrigated lands should be grown fruit, vegetables and other intensive crops, while wheat, corn and other grains and even much of the forage should be grown as extensive crops upon the non-irrigated or Dry farm lands. It is to be hoped that the time is near at hand when it will be a rarity to see grain grown upon irrigated soil." From the preceding rather long extract, it will be seen that wheat is being grown as a Dry-farm crop in America. Mr. Weigel has asserted that it is the same in the dry-regions of Australia. Why should not the Agricultural Department of Ceylon by successive crops of paddy breed and raise paddy that can be grown on non-irrigated land? As it is, we have at the present time in hand seed paddy. The Agricultural Society should encourage the extension of the cultivation of seed paddy. At the present time, loss in rice is a very serious matter in up-country estates. It behoves the Government therefore to do all in its power to extend the cultivation of paddy and to increase its production, not only in irrigable but chiefly in non-irrigable lands.

Then there are the leguminous crops which not only yield wholesome and nourishing food, but as nitrogen gatherers enrich the soil. The group of leguminous crops is of great importance; first, because, it is rich in nitrogenous substances, which are valuable animal food, and secondly, because it has the power of gathering nitrogen from the air to maintain the fertility of the soil. Dry-farming will not be a wholly safe practice in agriculture until suitable leguminous crops are found and made part of the system. It is

notable that over the whole of the Dry-farm territory of this and other countries, wild leguminous plants flourish. They do so in Ceylon—"Pila" or *tephrosia purpurea* grows wild in the poor sandy soils of Jaffna, Chilaw, and other dry-regions, and are taken in cart loads to manure Tobacco and other crops. The *Crotalarias* too grow wild on sandy soils everywhere.

It may be urged that the quality of the crops grown on non-irrigated lands is poorer than on irrigated lands. The recognition of the superior quality of practically all crops grown without irrigation, under a limited rainfall, has done much to stimulate faith in the great profitableness of dry-farming. I do not wish to burden this paper with too many extracts. Both at Rothamsted and on the Dry-farms in America, it has been established that the proportion of wheat to straw increases with a smaller rainfall. Crops come to maturity sooner without than with irrigation. This will allow of more frequent cropping. Another advantage of Dry-farming is that the soil does not require to be manured to the same extent as an irrigable farm. The constant stirring and aeration of the soil renders soluble mud of the insoluble elements of fertility in the soil. The older Dry-farms in Utah, which are among the oldest of the country have never been manured, yet are yielding better crops to-day than they did a generation ago. This is not true of the irrigated farms.

The reason why arid soils are more fertile than irrigated soils is said to be that the roots feed at a greater depth than on moist soils and therefore the upper layer of soil does not get exhausted and require manure. Another reason is that arid soils being deep, the rain water that is stored up when being drawn to the surface brings with it the elements of fertility from the lower soil layers. The soil of the lower layers in arid soils is richer than in humid soils as its mechanical condition permits of air entering great depths and rendering still soluble the insoluble plant-food in the soil.

In this connection, I may be permitted to offer a few remarks on the paper read by Mr. Drieberg at the conference held at Coimbatore. He stated that the Coimbatore Conference was against dry-ploughing of paddy fields. If I understood him aright he was not disposed to accept those conclusions as final, and suggested experiments. Mr. Bamber said that the conclusions of the Conference were right as the work of *Azotobacter* Bacteria will be disturbed and Nitrogen will be liberated. I will not presume to enter the lists against so qualified a scientist. But I may be permitted to quote Hall, who, I believe is acknowledged to be the first authority on Agricultural Chemistry in England. "The *Azotobacter Chrovcoccum* is able to fix atmospheric nitrogen in the soil without the aid of legumes. This bacteria is active in decaying vegetable matter and is aided in the action by the presence of lime in the soil. What if the stubble be ploughed in and the surface be dressed with lime? That should help the work of the *Azotobacter* in the absence of lime. Organic matter, by its decay gives rise to various acid bodies, which may be *grasped* as humic acid; and the acidity thus produced inhibits the action of many of the valuable groups of Bacteria, such as the *Azotobacter*, which give nitrogen and the nitryfying Bacteria which convert Ammonia into Nitrates." I was drawn into this digression by reading that in the earlier days of Dry-farming, it was thought that the stubble ploughed in would not decay and would leave the soil in a condition unfavourable for the

growth of plants. It has since been demonstrated that if the methods of Dry-farming are correctly followed, there will be sufficient moisture in the soil to decay the stubble and enrich the soil. The stubble is said to contain a large proportion of the Nitrogen taken by the crop from the soil and more than that of the Potash and Phosphoric Acid. The introduction of the Neader (ploughing in the high stubble) in Dry-farming was one of the big steps in making the practice certain and profitable. If the benefit be so great in Dry-farming, of ploughing in the stubble, how much more will it be in irrigated fields when the soil below the surface is moist, if ploughing is done immediately after harvest.

So far, I have attempted to satisfy those who are sceptical of the possibilities of Dry-farming in the arid districts of Ceylon, that what is possible elsewhere will be possible in Ceylon. I wish now to suggest to the Agricultural Society that it might take up Dry-farming either at the Agricultural Station at Anuradhapura or anywhere accessible by rail. With either an agriculturist specially got out from India, or with one of the Ceylon students sent to Poona, the cultivation of "Ell vi" or hill paddy and curry-stuffs might be undertaken, first on a small scale as an experiment. Ceylon imports from India about two million rupees worth of curry-stuffs annually. It produces very little for home consumption. If a half of these imports are homegrown, it will mean the circulation of about a million rupees among the poorest of the peasantry of this Island. If as is suggested the Jaffna Tamil cannot be induced to migrate far from his home, colonies of Indian Tamils might be imported and induced to settle down in the desert regions of Ceylon. This is an undertaking for the Government to embark upon aided by a sympathetic Government Agent of the Northern Province. Inducements will have to be offered to settlers on inhospitable areas.

A. W. BEVEN.

THE SO-CALLED NEW FERTILISER.

The reported discovery attributed to Prof. Bottomley of utilising peat as a medium for conveying nitrogen-fixing bacteria into the soil recalls the one-time popular "jadoo-fibre" which was introduced to Ceylon by the present Secretary of the Ceylon Agricultural Society, and was found to be an undoubtedly valuable fertiliser by those who tried it. The ingredients and preparation of "jadoo" which consisted of Peat moss saturated with various fertilising agents was described in the Queensland Agricultural Journal and an analysis also furnished.

It is suggested by the Queensland Journal that Megass from sugar mills might be found suitable as an absorbent material for similar purposes; and we have no doubt that dry coir dust might be employed in the same way.

C. D.

ENTOMOLOGY.

TERMITES.

Complaints have come recently from Maskeliya, Nanu Oya and Ruanwella of injury to tea by termites. In Maskeliya they had "destroyed a tea bush, going right down the stem and leaving only a shell; the same with the side branches." At Ruanwella "a large number of bushes shewed very few signs of borer (shot-hole borer) and yet the stems many of them are scooped out quite hollow and full of white ants."

In the latter case Red Borer had been present, and it is possible that the ants first began their attack in a tunnel of the borer.

The ants sent from Maskeliya comprised only workers.

In the collection from Nanu Oya soldiers, workers and 'Nymphs' were present. The 'Nymphs' were of rather a dark-brown colour.

The soldiers possess strong mandibles; the left mandible bears two teeth set close together, the right two teeth placed more proximately than in the left mandible, and more widely separated from each other. This termite is in all probability *Calotermes militaris*, Desn. which is known to have the habit of eating out the tea stems as described above.

The only remedy that can be suggested is that the nests should be destroyed, and for this purpose Carbon bisulphide is the most suitable substance, if one does not possess a Universal Ant Exterminator.

DYNAMITE.

On July 1st several large ant-hills were treated with dynamite by Mr. Doolan in the course of demonstrations on the use of dynamite for sub-soiling, ploughing, digging holes, breaking up roots and stones, etc.

A hole was driven horizontally into the hill at ground level, and a charge of dynamite exploded.

A careful inspection made after the discharge did not reveal a dead termite. Even the youngest of them were very much alive.

The earthwork was rendered very loose by the explosion, so that the ant hill was easily demolished.

On the following day although heavy rain had fallen during the night numerous ants were moving about in the neighbourhood of the disturbed nests, congregating under clods of earth.

On the 9th they had begun to build again. On the 24th the ants had disappeared, but a new nest had appeared about six yards away in a hole that had been dynamited for planting. In nests that were dynamited on the 10th ants were building briskly on the 24th. In this case the charge had not succeeded in disrupting the nest.

MR. BANDARA-BEDDEWELA'S MIXTURE.

On July 1st Mr. Bandara-Beddewela gave us a demonstration in the use of his termite mixture.

Three large nests were treated.

The treatment consisted in cleaning away the earthwork and exposing the tunnels just below the surface of the ground. This done, the mixture, which resembles wood-ashes, was sprinkled over the opened nest and over the earth, combs, etc., that had been thrown out.

A fourth nest was opened in much the same way but no mixture was applied.

Mr. Bandara-Beddewela claims that the ants will not build again in the places that have been treated. He does not know whether the mixture kills the ants or not.

The nests had to be left open for a week.

A heavy rain fell during the night.

On the following morning ants were still present in the nests. On the 9th they had begun to build again; the control was slightly more vigorous than the others, but this was probably due to the fact that the nest did not get quite so thorough a cleaning out.

On the 15th ants were still present and building small heaps of earthwork. On the 24th all nests were deserted, the control as well.

I am of opinion that what good was done was due to the fact that the nests had been broken up and disorganised, and not to any property of the mixture.

To test whether the mixture had the power of killing termites or was distasteful to them, I procured some rotting wood infested with termites. This I broke up into small parts and put into two boxes. One lot was copiously sprinkled with the mixture and the other was left as it was. Both boxes were left uncovered out-of-doors. This was on October 29th.

On November 6th termites were present in both boxes.

On the 1st of November I put rotting wood and termites into four test tubes, sprinkling three of the lots freely with the mixture and leaving one untreated. All tubes were loosely stoppered with cotton-wool. The termites remained and were quite lively on the 6th instant.

In connection with the preceding experiments the following facts emerged.

Ant-hills provide a favourite retreat for snakes.

Two species of large, black ants prey on the white-ants when the nests of the latter are broken up.

A Dipteron with bluish-green thorax and brownish abdomen was observed to hover round the disturbed nests in considerable numbers. They invariably settled on a mass of earth that gave them a commanding view of their immediate surroundings.

I watched for a long time, but did not see what it was they were after.

This fly looked very similar to one I have seen pouncing down on Cremastogaster sp. as they were carrying what were probably their pupæ up a tree-stem.

"CORDIROL."

Wood impregnated with "Cordirol" was sent by a firm in Hamburg with the request that I would test it against termite injury. Much is claimed for "Cordirol."

In a leaflet issued by the firm which sent the blocks of wood it is stated that "at last there has been put on the market a remedy in the form of Cordirol which, in simplicity of employment and certainty of effect, stands unrivalled. It protects useful timbers of every sort with absolute security whether these are employed on buildings, for carriage work (sic) implements, furniture etc. from destruction by "Termites."

"Timber impregnated with "Cordirol" is quite free from attack by termites, as numerous experiments in Ceylon and in various parts of Africa have demonstrated."

A substance having the properties here claimed for "Cordirol" would be a great boon.

Alas !

Three blocks of impregnated wood were received.

One piece I placed in a termite's nest on November 30th, the other two in separate nests on December 1st.

I dug them up on December 17th. The two placed on December 1st were badly eaten and would soon have been gone.

The third piece was untouched. No termites, however, were near it. A colony of brown ants with pupæ had taken up its abode in the tunnel in which I had placed it.

Thinking that probably they had kept the termites away, I introduced it on the 17th into the nest from which I had taken one of the other pieces.

On December 27th it was as badly channelled as were the other two pieces.

A. RUTHERFORD.

PLANTS OTHER THAN TEA FROM WHICH *XYLEBORUS FORNICATUS* (SHOT-HOLE BORER OF TEA) HAS BEEN TAKEN.

GREVILLEA.

We have a few records of Shot-hole Borer attacking Grevillea. In 1903 Mr. Green expressed the opinion that the insect is not at home in this tree, and attacks only sickly branches. So far as I can find there is no subsequent record that necessitates modification of that opinion.

The same has to be said regarding *Albizzia stipulata*.

ALBIZZIA MOLUCCANA.

There are several records of Shot-hole Borer attacking *A. moluccana*. The opinions regarding the state of health of the plants attacked differ.

In one case in which the plants were found to be badly infested, they were said to be apparently vigorous but to be growing on poor soil. A subsequent report concerning apparently the *same* case of infestation says that the borers were present only in sickly side-branches!

In another case the insects were found to be breeding freely in twigs that had apparently been killed back by a fungus; in another the branches that were attacked were dead or diseased, due to a "dieback" fungus.

In these cases several species of beetles were present and that in itself suggests that they were not the primary cause of injury. It is very interesting to read that in these cases tea in the district was not attacked.

In still another case the branches that were infested shewed no signs of original fungous disease. It is obvious therefore that *A. moluccana* must be regarded with suspicion.

CROTALARIA STRIATA.

A single case of attack, and that on twelve-month-old stems has been reported.

LOQUAT.

One case of attack is recorded, but as all the tunnels were deserted it is not known whether the beetle was breeding in this plant or not. Nothing is said regarding the presence or absence of signs of previous disease.

CASTOR.

One case of attack has been reported. The borer was present in an old stem in all stages. There is no mention of any signs of previous disease.

PARA.

Beetles which Mr. Green was unable to distinguish from *X. fornicatus* were found tunnelling in dead parts only; the original injury appeared to have been due to a wound.

MELASTOMA.

A single case has been reported. The branches were infested by shot-hole borer, but only a single insect was found in each tunnel and no eggs nor larvæ.

GUAVA.

Mr. Green has seen a single case of specimens of *X. fornicatus* that were said to have been taken from Guava.

BIXA ORELLANA (ANATTO).

The receipt of twigs of this plant that had apparently been perforated by *X. fornicatus* is recorded.

CACAO.

In 1903 Mr. Green wrote: "I have found signs of the borer in isolated cacao trees growing amongst tea, but the insect had evidently not found a congenial home. In nearly every case the tunnels had been abandoned before completion.

"The profusion of gummy matter in the bark of a healthy cacao tree is an efficient protection. But should the tree become weakened by canker or other disease it will probably be freely attacked."

Recently I have observed that cacao trees suffering from an advanced stage of canker do provide a most favourable breeding ground for *X. fornicatus*.

The branches require to be neither too little nor too much decayed, but, when they are just right, the beetle has been found present in large numbers in all its stages.

It is obvious that abandoned and neglected cacao is a distinct menace.

In cultivated cacao all dying branches should be completely removed and the cut surface tarred, and a look-out kept for any attack of the beetle.

In the galleries in cacao I have found several specimens of a large, black Thrips; it may be predaceous but it seemed to be exercising little control over the numbers of the beetles. I have never taken a single Thrips of any species in the galleries of *X. fornicatus* in tea.

AVOCADO PEAR.

Recently I have observed that an Avocado Pear tree growing in the vicinity of infested tea periodically suffers from the attack of a Scoly-tid, which Col. Winn Sampson has identified as *X. fornicatus*. So far I have never found more than one insect in each tunnel, and in most cases the tunnel has been empty. The position of the entrance to the tunnel is usually indicated by a white encrustation. Girdled twigs sooner or later fall over and hang limp and withered, to be brought down by the next windstorm.

It is recorded by Mr. Green that he had been informed that Lantana and Dadap are subject to attack, but there is no authenticated case of such attack on record nor has a case come under my notice.

I have seen cases of the invasion of *Poinciana regia*, *Bauhinia sp.*, *Aberia Gardneri* (*Ketambilla*, *S.*) when growing in proximity to infested tea, but these are without doubt to be regarded as cases of a sporadic overflow infestation. In the case of *Aberia Gardneri* and *Poinciana regia* the beetle is usually to be found entombed in an exudation of resin, and in the case of *Bauhinia sp.* the beetle never makes any headway.

A. RUTHERFORD.

THE CACTUS AS FODDER.

The question whether the prickly pear or the cactus, to give the shrub a more scientific name, can be utilised as fodder has, says the Bombay Gazette, been asked in India more than once, and the reply has usually been in the negative. Officials of the Agricultural Department at Poona, however, are able to report differently. It is stated in the Annual Report for 1912-13 that during the year important experiments have been carried out with the result that it has been proved conclusively that prickly pear, if fed with 6 per cent. of cotton seed, is a valuable emergency fodder in famine times. During the famine last year six bullocks were purchased from Ahmednagar and were fed on the compound mentioned. It is said that the spines of the cactus can be burnt off with kerosene flare lamps and the pear prepared at a cost of Rs 1-4 per 1,000 lb. in a day of ten hours. The food was tested practically at Manji when fodder was dear with apparently satisfactory results. Additional testimony comes from the Collector of Ahmednagar, who informed the Director of Agriculture that "the demonstrations of the use of pear carried out by the Department at the cattle camps were very successful and have convinced the leading cultivators." As it is calculated that two bullocks can be fed with pear and cotton seed at a cost of less than five annas a day, and the cactus grows in abundance in Poona and many other districts in the Bombay Presidency, one of the most serious problems to be faced in famine would appear to have been solved.—Indian Agriculturist.

POULTRY.

THE BREEDING OF EGG-LAYING POULTRY.

The last number (January) of the Journal of the Department of Agriculture for Ireland contains a most instructive article on this subject by Mr. James Wilson, Professor of Agriculture. It deals with Dr. Raymond Pearl's work at the Maine Agricultural Station on the inheritance of the egg-laying propensity.

Hitherto the fundamental ideas governing all attempts at improving the egg-laying power were that that power ran in strains, and that both parents were equally responsible for the progeny. These ideas are now proved to be fallacious, for the strain may be broken even in the immediate progeny of the very best parents, and of the causes of good egg-laying one at least does not descend through the female. The results of Dr. Pearl's investigations have followed a long course of patient and persistent experiment in illustrating complicated phenomena which conform with the Mendelian theory. It is therefore necessary to have some acquaintance with this theory in order to thoroughly grasp the significance of the investigations referred to. We are, however, presuming that the reader has such an acquaintance; but if not he should read the article *in extenso*.

Among poultry as among other animals the sexes are about equal on the average. To account for this, the theory has been established that while the male is pure as regards the factors controlling sex the female is hybrid.

As regards mating it has been found that the breeder has two options.

(1) To mate a highest-grade cock with a number of highest grade hens without endeavouring to distinguish the impure hens from the pure. If the descendants of such a stock of hens be mated in every successive generation with highest-grade cocks only, the proportion of pure high-grade birds of both sexes will gradually increase until eventually all are pure, but no one can say when that stage will arrive; and, until it does arrive, the stock will continue to throw impure birds of both sexes. For some generations, no bird can be guaranteed of the highest grade and pure, and even then only after an exhaustive inspection and possibly a troublesome test.

(2) To identify the hens of highest-laying grade that are pure and mate them with a highest-grade cock. In this case the progeny of both sexes are all of highest grade and pure. The initial trouble is to identify the pure highest-grade hens.

With reference to mating we are told that this can be done in two ways:—

(*a*) If a number of highest-grade hens be mated with a male known to be of the bottom grade, the pure hens could be separated from the impure by the performances of their daughters. The former's daughters should all

be medium grade while some of the latter's should be bottom grade. The former should all lay eggs during their first winter, while some of the latter should lay none.

(*b*) If a number of highest-grade hens be mated with a highest-grade cock, the pure and the impure could be distinguished through their son's daughters. Mated with the lowest grade of hen, the sons of pure mothers would get highest grade daughters only, while the sons of impure mothers would get some medium-grade daughters.

In this connection it is worth mentioning that high laying powers are not confined to the so-called laying breeds and that laying and the table qualities may be found in the same child; and further that so long as the originally selected parents are strong and healthy there need be no fear of in-breeding.

An important observation arrived at with reference to this subject is that a hen's total yield for a year could be predicted approximately from her yield a few weeks after she has begun to lay. The great value of this observation lies in the fact that the breeder knows before the setting season begins the grade to which his pullets belong and he can infer therefrom the parents' grade.

We would advise those who are specially interested in this subject to study the article referred to in its entirety.

C. D.

THE VALUE OF CHARCOAL FOR POULTRY.

ALFRED DINSLEY, F.R.M.S.

"Trifling Precautions will often prevent Great Mischiefs."—Sharpe.

With the advent of the chicken-rearing season there will be ushered in the usual ailments of young feathered stock, ailments which materially affect the profit account of the poultry-keeper. Last season the writer fully described the pathology of chicken enteritis—which term enteritis can be taken to cover the popular but vague one of "bowel complaints."

In this article the prevention of diseases of the alimentary canal will be dealt with, and, for the benefit of the old and the many new readers of this journal, a word will be said of the value of charcoal in the poultry yard and farm.

Let us start with the newly-hatched chicken.. Let us examine its dietary, the structure of its digestive system, and perhaps we shall ascertain the primary cause of the bowel ailments which are responsible for the high death-rate of young feathered stock.

In commencing, we must examine the newly-hatched chicken. We know that shortly before it makes its entrance into the world it absorbs the remains of the yolk-sac, which originally encompassed the germ-plasm. The yolk is composed of vitellin, fat, chloresterol, lecithin, and water. It is essential to

take into consideration the chemical composition, since it will help us to arrive at a common-sense diagnosis. When the chicken is out of its shell it is kept warm and as comfortable as possible, and it is not allowed to partake of food for a period of thirty to thirty-six hours. This allows the absorbed yolk to digest, and prepares the alimentary canal for the reception of food from an outside source.

DELICACY OF CONSTRUCTION.

The alimentary canal of the chicken is one of the most delicate structures it is possible to conceive ; there is a tiny œsophagus or crop which macerates the material taken in ; a wonderful little stomach which treats the foodstuff immediately before the latter enters the gizzard, which is a compact organ occupying more than one-half of the abdominal cavity. Then there is the duodenum, which is attached to the gizzard, and afterwards forms a loop which couples up with the small intestine. The outstanding feature of the above-mentioned organs is the delicacy of their construction.

Externally, there is little to be seen of the anatomy of the chicken ; and apart from the beauty of the fluffy little creatures, there is one important factor to which it is necessary to direct attention.

THE DANGER ZONE.

Carefully examine a newly-hatched chicken. Pass a finger down the breast and abdomen, and by manipulation you will ascertain that there is little protection for the organs contained in the lower part of the abdomen. The sternum, or breastbone, abruptly ends ; and with the exception of thin membranes and the epidermis there is nothing to preclude the action of climatic conditions on those portions of the alimentary canal lying near the surface. That is to say, there is nothing to prevent the action of dampness and cold upon the organs situated near the surface of the abdomen.

This region is *the danger zone* of the chicken, and it is here that the primary cause of intestinal ailments has its origin. The primary cause is fermentation, which is brought about by any of the following causes ; unsuitable and indigestible food, dirty or polluted drinking water, exposure to cold, draughts, or other adverse climatic conditions.

UNSUITABLE FOOD.

Thus there are many causes of fermentation of foodstuff in the alimentary canal. By unsuitable foodstuffs is meant foodstuffs containing anything of an irritating nature, mouldy substances and substances of an indigestible character. Among the latter may be classed hard-boiled eggs, which constitute the first feed of many chickens.

Whatever the cause of fermentation, whether it be irritant compounds, polluted drinking water, or unsuitable food, there remains a method by which fermentation can be prevented and abolished, namely, the administration of liberal quantities of charcoal. Charcoal is one of the finest intestinal disinfectants known on the poultry farm.

PREVENTION.

For young chickens the granulated charcoal should be well mixed into the mash or soft food : but for older stock it is advisable to place it in a hopper or box where they will have access to it.

The employment of charcoal on the poultry farm in the way suggested will reduce the death-rate, prevent malnutrition and bowel ailments, and enable the poultry-keeper to rear better birds. In short, it is impossible to over-estimate the value of granulated charcoal to the poultry industry.—"Poultry."

ROUP OR CONTAGIOUS CATARRH.

The following is taken from the same source as the article on Chicken-pox published last month :—

Roup appears to be a strictly contagious disease. The contagion is generally brought in to the poultry yard by infected birds. Sometimes these are birds which are purchased from other flocks in which the disease exists. Sometimes they are birds of the home flock which have been to exhibitions and there exposed to sick fowls, and sometimes they are wild birds or pigeons which fly from one poultry yard to another.

SYMPTOMS.

The symptoms first seen are very similar to those of an ordinary cold, but there is more fever, dullness, and prostration. The discharge from the nasal opening is at first thin and watery, but in two or three days becomes thick and obstructs the breathing. The inflammation, which begins in the nasal passages soon extends to the eyes and to the spaces which exist immediately below the eyeballs. The eyelids are swollen. The birds sneeze and shake their heads in their efforts to free the air passages. The appetite is diminished and the birds sit with their heads drawn in, wings drooping and having a general appearance of depression and illness.

TREATMENT.

The medical treatment of this disease may be very successful if properly applied. The sick birds should be removed from the flock and put in a warm dry room. The affected mucous membranes should then be treated by applying antiseptic and healing mixtures. The remedies most suitable are, Boric acid 1 oz., water 1 quart, or, Permanganate 1 dram, water 1 quart.

The best method is to use a good spraying apparatus and spray the affected parts.

AGRICULTURAL SHOWS.

Mrs. Marion Edley of the Carlton Hotel, Nuwara Eliya, writing to the Honorary Secretary of the Ceylon Poultry Club, says:—"I am always ready to help on anything for the improvement of cattle, poultry, etc., as I am sure these shows have a world-wide influence on the nation. The eggs which are brought in from villages are twice the size and better. Of course, we have to pay more, but one does not mind that."

GENERAL.

LUCERNE.

H. H. MELLE.

(*Contd: from page 237*)

TREATMENT OF YOUNG LUCERNE.

The life of a lucerne plant will largely depend upon its treatment when young. Weeds often come up to crowd the young lucerne. To destroy these weeds mow the crop with the mower, setting it to run as close to the ground as possible. If a mower is not available use a sickle—the labour of cutting it will repay every time. On no account allow animals to graze on young lucerne. It is better not to pasture lucerne until it is three years' old. By cutting young lucerne the growth is stimulated, but by pasturing the reverse is the effect. Another point to remember is not to allow lucerne to run to seed the first season, as this tends to set back the plant considerably.

HARVESTING.

The first point to accentuate on this subject is the great value of the leaves. These contain from 75 per cent. to 80 per cent. of the protein of the whole plant—that valuable compound that goes to produce milk and meat. It is estimated that the loss in leaves in harvesting ranges from 15 to 30, or more, per cent. It is readily seen that the harvesting is an important part in lucerne-hay making.

WHEN TO CUT.

The time to cut lucerne is when it has begun to bloom—say, about a tenth in bloom—just as the lower leaves begin to turn yellow and drop off and buds start out from the base of the stems. Cut now, for it contains then the greatest quantity of nutrients. If allowed to stand longer the stems become woody, some of the leaves are lost, and the hay is not as palatable, nutritious, or digestible.

MAKING LUCERNE-HAY.

J. E. Wing says:—"There is a principle to be observed in making alfalfa-hay that applies to making hay from all clovers. If it can be so managed that the leaves are not at once burned and dried to powder the moisture from the stems is the most easily removed. Leaves are natural evaporators of sap; stems are not. Therefore, while the leaf has yet pliancy and some semblance of its natural condition, it is most effectively carrying away the sap of the stem, but when it is dried up it no longer aids in drying the plant at all. Therefore the best hay in all respects is made partly in the shade, in loosely turned windrows, or in narrow cocks." During hot, dry weather it is better to cut for hay making during the cooler part of the day, preferably in the afternoon. Allow it to be in the swath until the leaves become wilted, then rake into windrows and later into cocks. The time from cutting to making into cocks will depend entirely upon the climatic conditions. The art of making good lucerne-hay is only to be acquired by practice.

TO TEST FOR SUFFICIENT DRYNESS.

Before stacking the hay, it must be sufficiently dry in order to prevent over-heating in the stack. A simple test is to take a wisp of hay, choosing a damp part of it, and twist it violently into a rope. If no moisture can be made to exude from the stems the hay may be put into the stack. If only a

small quantity of hay is to be made it should be well dried before stacking since it is more apt to become musty than when a large amount is piled together.

STACKING.

Stacking the hay directly on the ground is sure to mean a loss of some portion of it. Elevate the bottom of the stack with timber and put straw at the bottom, also preferably build a rick rather than a round stack. Start the bottom 12 to 14 feet wide and build straight up. Keep the stack full in the middle, or a little higher than the sides, and well tramped all the time. When the stack has reached the desired height, top it with grass, if possible, as grass sheds water better than lucerne, or better still, cover it with tarpaulins well weighted down.

ADVANTAGES OF LUCERNE.

(1) That it roots so deeply in the soil. It is considered that lucerne roots penetrate as deep as there is any soil. Thus the whole soil is utilized.

(2) That the plant uses the whole growing season. It is very hardy and does not much mind cold. In spring, as soon as the weather becomes warmer, the lucerne is up and growing. The number of cuttings you will obtain will depend upon the amount of moisture in the soil and your local climatic conditions.

(3) The forage that the lucerne plant produces is the richest and the most palatable that the farmer can grow. The hay, if properly cured, is very rich in protein. It is the best feed for the baby on the farm—for the baby colt, the baby calf, the baby lamb, pig, and chick.

PASTURING.

In some respects lucerne does not seem to be a natural pasture plant. The stems are delicate, it will not thrive in a hard trampled soil, and the crowns when broken off will not readily revive; if some of the plants flower and drop their flowers early in the season, they lose vigour. Not an animal should be turned on to a lucerne field until the second or third year if it is desired that the stand endure for several years, nor should it be pastured too early in the spring or too late in the autumn. There should be something of a growth left for winter protection. Careful lucerne growers are known who pasture their older fields, but never put on a full quota of stock until they have cut over the field when the plants are first coming into bloom. They insist that this cutting invigorates and gives the plants new life.

HORSES AND MULES.

There is no *one* thing so good as lucerne for the working horse. It builds up his wasting muscles, it keeps him strong and healthy. He needs much less grain when he can have lucerne-hay. It is necessary to remember that this hay should be fairly mature when it is cut, and well cured, and that it should not be mouldy or musty. For old and hard-worked horses in thin flesh lucerne has great restorative powers; for horses doing fast work a little grain should also be given. It should be constantly borne in mind that well-cured lucerne-hay is nearly as rich as wheat bran, so that to feed too great an amount of it is not merely wasteful, but puts an undue strain upon the excretory organs to eliminate the unnecessary food substance from the tissues. Lucerne is second to no other feed for the mare while she is carrying her unborn foal. Lucerne being a voracious lime, potash, and phosphorus feeder it is without parallel as a bone maker for young horses.

CATTLE.

Heifer calves raised on lucerne develop rapidly and are ready to become mothers earlier than when developed on other foods. Cows in milk feed on

lucerne-hay as part of their ration give milk as with no other possible combination. The great dairy authority, Ex-Governor Hoard, has found in practice that with a combination of lucerne-hay and good sweet mealie silage, and as little as from four to five pound daily of grain, not only has he had the maximum returns in milk and cream, but he has seen the dairy herd maintained in remarkable health and vigour. Mr. Wing writes: "Fattening cattle are desired to be fattened as rapidly as possible; why, therefore, need they be fed any foods rich in protein? Why not feed them in the old-fashioned way with corn (mealies) alone, to quickly cover their ribs, and then let them go forward to market? The theory sounds well, but does not work well in practice. These animals find waste going on in their own systems. Digestive processes require muscular action, and there is need to repair muscular tissue. Nerve force is to be maintained. Then, after all, when the animals come to the feed lot they seldom have an adequate frame of lean tissue on which to build the fat. Moreover, the modern trade demands lean flesh intermixed with fat, not fat laid on in masses. And, finally, digestion goes on better when there is fed a variety of foods containing both fats and muscle builders. So theory backs up practice, and that tells that steers fatten more quickly, more cheaply, and better when they have all the alfalfa-hay they want in combination with corn." Oxen are said to fatten in from ten to sixteen weeks if grazed on lucerne.

SHEEP.

Sheep prefer lucerne above all other forage, and for a good reason. It is the one thing best suited to their needs. They, more than other animals, need a ration rich in protein. Think for a moment what it means for an animal to like a food. Liking in the animal world is not whim or caprice. Man is the one animal, save a worm, that chews tobacco, the only animal that drinks whisky. All animals crave things that are good for them. Why do they hunger for fitting foods? Because the very cells of their bodies are calling to be built up, and this instinct tells them that tough grasses nourish feebly, if at all; that tender, rich lucerne leaves and stems have in them substances which, when assimilated, go directly to build the eager body cells, to reinforce the muscles and strengthen the bones and brace up the nervous system. Sheep, when once accustomed to a diet of lucerne, will scorn veld grass.

What has been said of the mare applies as well to the ewe and cow.

DANGERS TO CATTLE AND SHEEP.

The greatest objection to pasturing lucerne is its bloating effect upon cattle and sheep. Pigs and horses do not suffer. Professor Coburn drew up the following rules for pasturing:—

At the beginning of the pasturing season give animals a heavy feed in the morning before turning upon on the alfalfa.

Have water in the pasture all the time.

Keep the animals in the pasture night and day, after they have become accustomed to it, until removed permanently.

Use upland in preference to bottom fields for pasture.

Watch the stock closely the first few days and remove those permanently that show symptoms of bloat.

Sow blue grass, brome grass, or meadow fescue with alfalfa in fields intended for permanent pasture.

PIGS.

Farmers claim that pigs a few weeks old turned into a lucerne field derive almost their entire living from it, and leave their mothers two weeks earlier than when fed otherwise. Great care must be observed not to overstock a lucerne paddock with pigs, as they will then uproot the plants in a very short time.

POULTRY.

The lucerne field is a rich storehouse for the poultry-keeper. In summer the fowls forage far and wide, eating the tender leaves rich in protein, and, incidentally, all the insects. Fowls given all the lucerne that they desire are more healthy and lay more eggs than without it.

LUCERNE AS AN APPETIZER.

The high feeding value of lucerne is largely due to the chemical compound known as protein; its extreme digestibility is another desirable quality, and not the least is its appetizing character. Not only do all animals like it, but when given in moderate quantities it seems to increase the general appetite for more fat-making feeds. Animals fed on lucerne grow in weight, but the weight is principally of bone, blood, and muscle. It is without a sufficiency of fat and carbohydrates, and these should be supplied by the addition of such foods as mealies and kaffir corn. When lucerne is fed alone, all the protein cannot be digested, and it is, therefore, always economical to add some carbonaceous foods if animals are fattening for market.—South African Agricultural Journal.

BASIC SLAG.

The great importance and extensive use of Basic Slag as a manure make it desirable to remind intending users of a few points as to its purchase, and its use on different soils and crops.

Basic Slag, as is well known, owes its value to the fact that it contains phosphate of lime in a more or less readily available condition. It usually contains also a considerable proportion of lime capable of neutralizing acids in the soil, though probably not more than 2 to 5 per cent. is in the form of "free" of "caustic" lime. Obviously, then, the first thing to be ascertained in buying basic slag is the percentage of phosphate of lime which it contains. Furthermore, the availability of the phosphate in different samples varies. As a rough guide to determine whether the phosphate is likely to become "available" or useful to plants in a reasonable time, a method often adopted, and officially recognised under the Fertilisers and Feeding Stuffs Act, is to ascertain the percentage soluble under standard conditions in a 2 per cent. solution of citric acid. While this method is only expected to give approximately correct information, it may safely be assumed that the value of a sample of slag is roughly proportional to its content of phosphate soluble in the approved solution of citric acid.

FINENESS OF GRINDING.

As influencing the availability, the fineness of grinding is extremely important, and along with the guarantee of the amount of phosphate present, a statement as to the proportion of the slag which will pass through a sieve having 10,000 meshes per square inch should be obtained. This proportion should not be less than 80 per cent., and samples 90 per cent. of which will pass through the sieve are readily obtainable.

MOST SUITABLE GRADE OF BASIC SLAG.

There is often discussion as to what is the most suitable quality of basic slag for general use. It is possible to obtain slag called basic slag containing very little phosphate at all, while on the other hand the richest samples contain up to 50 per cent. of "total phosphate of lime." The solubility of this total phosphate, however, varies very much in different samples, and there is no definite relation between the richness of slag in phosphate and its solubility. For instance, in one of a series of samples of which detailed

analyses are available, the total phosphate of lime amounted to 27 per cent., and 93 per cent. of this was soluble in a 2 per cent. solution of citric acid ; in another containing 45 per cent. total phosphate of lime, only 70 per cent. was soluble ; in still another sample, containing 20 per cent. total phosphate of lime, only 66 per cent. was soluble.

This question of which quality should be used is chiefly one of cost. From the crop's point of view, what is required is a sufficient supply of available phosphate, and whether this is supplied by a small quantity of a high quality slag, or a large quantity of a low quality slag, is immaterial. Every farmer intending to use basic slag should obtain quotations for different grades from one or two merchants, and calculate what 1 per cent. of citric-acid-soluble phosphate would cost him in each case. As an example, a case which recently came to notice may be quoted. Two grades of slag, containing 26 per cent. and 34 per cent. "citric soluble phosphate" were offered at 45*s.* and 55*s.* a ton respectively, both quotations including carriage ; the cost of 1 per cent. citric-acid-soluble phosphate in the first case is 45*s.* divided by 26, or 1*s.* 8¾*d.* ; in the other case it is 55*s.* divided by 34 or 1*s.* 7½*d.* Clearly the latter is the cheaper manure, and, generally speaking, it may be said that the higher qualities of slag are really cheaper than the lower grades, particularly when the greater cost of carriage, carting, and distribution of a given quantity of phosphate is taken into account. Without going so far as to say that a purchaser should insist on having a high quality slag, it is safe to say that, as a rule, one containing not less than 15 per cent. of citric-acid-soluble phosphate should be employed.

SOILS.

Basic Slag usually gives its most striking result when applied to poor pasture on heavy clay soil. The results obtained at Cockle Park and detailed in a supplement to the Journal of the Board of Agriculture and Fisheries (January, 1911), are most striking. The alkalinity of the slag renders it also a very suitable manure also for peaty and sour soils. Even very light soils deficient in lime sometimes respond well to an application of slag.

DANGER TO STOCK.

The idea is sometimes entertained that basic slag, if taken even in small quantities, may be highly injurious to stock ; it may, therefore, be observed that there is no danger of special injury resulting from the consumption of small quantities It is, however, advisable to wait until a heavy shower has washed most of the slag off the herbage before turning stock into the pasture.

It is, perhaps, well to point out that, while basic slag usually gives excellent results on poor clay soil, a small area should always be treated, and the effect observed before expending any great sum on the manure. Although it is usually not so well suited for light or chalky soils as for clays, such soils have in some cases benefited materially from its application. Here again, however, a field trial must be made before definite conclusions as to its effect can be drawn. On light soils, in addition to trying the effect of slag alone it is also advisable to test the effect of adding kainit (at the rate of 3 or 4 cwt. per acre). Potash is seldom required on heavy clays, but may be needed just as much as phosphate on light soils. On the poor pastures on which slag proves effective, nitrogenous manuring, either in the form of dung, nitrate of soda, or even cake feeding, seldom does good and often does harm. The improvement of such pastures is best effected by encouraging white clover ; direct application of nitrogenous manure tends to help the grass to suppress what little clover is present. Leaflet No. 267.—Bd. of Agric. and Fisheries.

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THE INDIAN AGRICULTURAL COLLEGES.

It is a curious fact that while there is a persistent demand put forward in the Legislative Councils and elsewhere for more technical education the branch of technical education which India most needs and which opens up profitable employment still fails to attract students. The explanation of this contrast is obvious. What the members of Legislative Councils want when they ask for technical education is a scientific training which will, as they think, lead to the establishment of industries and manufactures. They have not yet grasped the fact that technical instruction is useless unless industries exist to which it can be applied. Even the melancholy experience of young men who have gone abroad to receive technical training and on their return have found no demand for their services seems to produce no effect on these amiable agitators, who cling to the belief that if only the Government will multiply technical colleges the industries must come. Meanwhile the scientific provision made for the greatest industry of the country—its agriculture—remains unnoticed because middle-class legislators whose lives are spent in towns either do not realise the possibilities of agriculture, or fail to perceive that it is an industry, or look upon it as merely an occupation for the lower classes. At any rate the fact is undoubted that the agricultural colleges admit a very small number of students and that the majority of these students are not of the right class. The number of students on the roll of the Agricultural College at Sabour at the end of June 1913, was 27, and the yearly admissions are "steadily decreasing." The province of Assam awards a scholarship of Rs 20 a month to a student who will undertake a three years'

course at Sabour. A Mohamedan candidate received the scholarship, but he left the college soon after joining it because he objected to manual labour in the field. A Sylhet Hindu proved equally unsatisfactory, for he too speedily left Sabour, doubtless for the same reason. According to the Assam Director of Agriculture "the average entrance-passed student has neither aptitude nor liking for agriculture. He strongly objects to any form of manual labour, and is not even willing to undertake the minimum amount of practical work on the farm attached to an Agricultural College necessary to enable him to get a grasp of the principles of agriculture." In the United Provinces the number of students who entered the Agricultural College last year was 51, of whom 40 were nominees for the subordinate revenue service and had obviously no intention of devoting themselves to agriculture. At the Lyallpur Agricultural College, in the Punjab, the dearth of students has become farcical. After the scholarship examination in May, 1913, seven out of eleven candidates were awarded scholarships. Five fee-paying candidates were also admitted. But of the twelve thus selected "not one presented himself when the session opened." The report of the Agricultural College of the Central Provinces relates much the same experience. "The year's entry of new students at the Agricultural College," writes the Director, "was numerically disappointing, owing to an unusually large number of candidates who did not appear after permission for admittance, or who, after arrival, soon abandoned the College." The actual number of first-year students was 14, and it is not surprising to find that Sir Benjamin Robertson states that "the problem of obtaining boys of the true agricultural castes, with the necessary standard of education, for admission to the Agricultural College, and subsequently to the department, is still as difficult as ever of solution." "Even in Madras the applications for admission to the Agricultural College show a decline for which it is not easy to account." The one exception to the dismal aspect which agricultural education in India presents is to be found in Bombay. Here also the number of students is not what it should be, for there are only 43 first-year students at Poona. But Dr. Mann writes with enthusiasm of the prospects of the College. A larger portion of the students than ever before have gone to work on their own land. A demand for trained men has arisen, and more are wanted than can be furnished. "Private land-owners, local bodies, agricultural associations, and the like, have all applied for men during the past year, and a number of them cannot be supplied." Dr. Mann does not, however, conceal the fact that many of his graduates do not care to take employment under private owners, and the statistics show that out of 17 who found employment last year ten went into Government service of one kind or other. Taken as a whole the various agricultural colleges, which are maintained at an annual cost of between five and six lakhs, are attended by a quite inadequate number of students, of whom the majority have not the least ambition to become skilled agriculturists. In England such institutions as the Cirencester Agricultural College attract the sons of landowners and large farmers who desire to pursue agriculture as a business and recognise the necessity of receiving a suitable scientific training. In this country the young men who go to the agricultural Colleges merely wish to qualify for a post under Government, and reluctantly submit to the manual labour which is an indispensable condition. This disappointing conclusion illustrates the extent to which the present system of education and the ideas of respectability which it generates tend to divert young men from an honourable calling in which brains and energy would secure a competence to the empty dignity of official employment or to the overcrowded professions. Those public men who recongise that the rush into Government service and the professions is demoralising to the community, and who look for a remedy in the creation of new industries, may well consider the question why India's chief industry is thus neglected.—Indian Agriculturist.

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THE VEGETABLE OIL INDUSTRY OF MARSEILLES.

The following abstract from Mr. Consul-General Gurney's report on France appears in Tropical Life of February last :—

Of the annual value of the total output (£52,120,000) of the principal industries of Marseilles, vegetable oils, raw and manufactured, can be said to account for £17,000,000: say oils and oil-cakes, £14,000,000 and soap-making £3,000,000, to say nothing of candles and wax, £875,000, and lard, etc., £1,600,000, into which vegetable oil substitutes may or may not enter.

Last year, 1912, was a comparatively poor one in the oil trade (the chief industry of Marseilles, as can be seen by the above) owing to the high prices of the raw material. This being so, we wonder what the report for 1913 will say when it is published. The Ministerial crisis and the strained international situation during the summer and autumn also had a depressing effect. The total number of oil factories in Marseilles is 45, containing 1,941 presses, with a capacity of 1,000 tons a day. The principal factories specialize, either in crushing seeds, dealing chiefly with copra and coconut oil, or with cotton seed and ground nut oils, edible cotton seed oils, and deodorized oils. Only one firm crushes linseed, imported from Bombay, for the production of edible oils. This is consumed in certain parts of France as a substitute for walnut oil. About 225,000 tons of groundnuts were imported, from which 50,000 tons of oil were produced, being equal to $4\frac{1}{2}$ tons of nuts to one ton of oil. Imports of copra amounted to 175,000 tons from which some 100,000 tons of oils are returned as being produced, or 1 ton of oil to each $1\frac{3}{4}$ tons of copra, which must have contained, therefore, nearly 60 per cent. of oil.

It is estimated that some 30 per cent. or 30,000 tons, of the coconut oil is used for edible purposes, i.e. to make coconut butter, whilst the 70 per cent. goes for soap-making. The chief feature of interest during 1912 was the large increase and development of the new process for neutralizing and deodorizing the ordinary quality of groundnut oil, previously only considered suitable for soap-making, and utilized for that purpose. By this process, however, the oils are made perfectly sweet, and they are largely bought for edible purposes. It is estimated that nearly one-third of the production of oil from the Madras crop of ordinary decorticated groundnut kernels has been thus converted into edible oils. Owing to this and the high price of oil the olive oil industry has been passing through a severe crisis. The deodorizing is, we are told, also beginning to be applied to olive oil.

THE JUTE INDUSTRY OF CALCUTTA.

Probably few persons in England who buy a sack of potatoes or a piece of linoleum realise that the useful bag and the fabric of the linoleum have both come from a plant which was grown in Eastern Bengal, was steeped in an Indian river, and was made into sacking or cloth on the banks of the Hooghly. Still less would the purchaser of a sack grasp the fact that year by year an area of Bengal, equal to that of Somerest, Wilts, Gloucester and Dorset combined, is covered with this tall but otherwise undistinguished plant. He will have heard of paddy fields, but the chances are that he will not know that jute, the source of sacks and sacking, is the crop which has brought wealth to the cultivators of Eastern Bengal and is the raw material of one of the richest industries in India.

PART OF THE ROMANCE OF COMMERCE.

The history of jute is a part of the romance of commerce. The fibre was first mentioned in the Customs returns in 1828-29, when 364 cwt. were shipped to the United Kingdom. The rapidity with which jute grew in favour has often been describd, and it is only necessary to state here that, as against 364 cwt. exported at the end of the first quarter of last century, the quantity exported in 1911-12 was 16,203,000 cwt., the value of which was over fifteen millions sterling.

The centre of this vast industry is, of course, Calcutta, and during the jute season the conveyance of jute to this city taxes the resources of the railways. The rivers are thronged with country boats bringing jute to Narayangune and other centres, and with large flats, towed by steamers, which carry astonishing quantities of the staple fibre of Bengal into the port of Calcutta.

EXTENT OF THE OUTPUT.

But the collection and export of raw jute are only half of the story. In 1855 the first jute mill was reared on the banks of the Hooghly, and produced jute yarns to the amount of 8 tons a day. By the year 1909 the output of yarn had reached a total of 2,500 tons a day. There are now about 60 mills, in the erection and equipment of which a capital of about eight millions sterling has been invested. It is sometimes supposed that in order to find an industrial community in India one must go to Bombay. Bombay capitalists, with their wails over the cotton excise duty and with their genius for daring speculation, have given their city a prominence to which Calcutta has not aspired. But it is a mistake to confuse notoriety with pre-eminence in trade and commerce. As is pointed out in the Indian "Moral and Material Progress" Report for 1911-12, "the factory population is largest in Bengal, where, besides the jute mills and presses, there is a great variety of industries employing a few hundreds or thousands of persons each. Iron and brass foundries, tile factories, paper mills and silk filatures are prominent in this part of India. Bombay takes second place."

CULTIVATION OF JUTE.

There are indeed few spectacles better calculated to give an impression of the growing industrial importance of India than a well-equipped jute mill, where a myriad spindles and looms convert the fibre received from Serajgunge or Narayangune into yarn and cloth. In the 60 jute mills and 85 jute presses about a quarter of a million persons find employment. The value of the jute manufactures annually exported has ranged in the last five years from £10,671,000 to £12,198,000, and there is every reason to anticipate that the industry will undergo a continuous expansion as time goes on. The fibre produces the cheapest fabric which civilisation has yet evolved, and there is no fabric which is more necessary to supply the means of transporting wheat and other grain. The only danger which threatens the industry

is the lack of adequate expansion in the supply of the raw material. It might have been supposed that a crop which puts many millions sterling a year into the hands of the cultivators would be extended out of sheer self-interest. In some measure this increase of cultivation has been secured automatically. In 1891 the acreage was 1,403,000; it has now risen to 3,353,000. But the expansion has not kept pace with the wonderful progress of a most successful industry.

ORGANIZATION OF THE INDUSTRY.

Efforts have repeatedly been made to grow jute elsewhere, and the plant has in fact been successfully cultivated in the United States and Brazil. There have been attempts also to secure a substitue for jute as a material for cheap bags. But only in Bengal are the conditions to be found which favour the production of jute at a low cost, while the proposed substitutes have one and all failed to answer the purpose which jute fabrics so admirably fulfil. The fact that this year the government of the United States have found it necessary to reduce the duty on jute bags and sacks is an eloquent testimony to the reality of the profitable monopoly which Nature has given to Bengal and Calcutta.

But Calcutta is not content to rely upon natural advantages. Measures are being adopted to place the jute industry in a stronger position, and there can be little doubt that before very long a better official organisation, improved cultivation, and the spread among the cultivators of a knowledge of the advantages of jute-growing will serve to ward off any danger of competition, and that jute will retain its place as "the cheapest and most easily manufactured of all fibres."—Indian Agriculturist.

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VALUE OF WILD BIRDS.

DR. E. WARREN, DIRECTOR, NATAL MUSEUM.

The Jamaica Agricultural Society Journal has reproduced the following article from the Agricultural Journal of the Union of South Africa with slight alterations to suit conditions in Jamaica:—

In this brief article it will be shown that bird life is of the utmost importance in the economy of Nature, and that its due preservation and encouragement are matters of vital interest to all agriculturists, stock-breeders, fruit-growers and gardeners.

It is true that certain birds at some seasons of the year may be seen eating fruit and doing a considerable amount of mischief ; but the hasty conclusion that the birds should be destroyed will be found on closer consideration to be fallacious and liable to lead to disastrous results.

Some birds are of more economic value than others, but those which take their annual toll of fruit or grain have themselves been instrumental in permitting the crops to grow by the destruction of insects and other vermin during the remainder of the year.

Birds being exceedingly active creatures, and their body temperature being higher than that of any other vertebrates, requires, relative to their size, an exceptionally large quantity of food.

The food is very various in nature, ranging from snakes and small mammals to insects of almost microscopic proportions, and in the vegetable world, seeds, berries, etc., are consumed.

Mammal-vermin, such as rats and mice, and destructive insects are capable of multiplying to an alarming extent, and the great value of birds in acting as a natural check is being conclusively proved wherever the subject has been investigated. It is found that near towns, where the birds have been more especially persecuted and driven away, the growing of fruit and other market produce has become increasingly difficult, or even impossible, owing to the prevalence of fruit-fly and other insect pests.

In the United States of America careful investigations of the nature of the food of many kinds of birds have been made. The contents of the stomach have been examined, and in the great majority of cases the food is shown to consist of just those kinds of insects, ticks, wireworms, etc., which constitute a menace to the stock-farmer, agriculturist and market-gardener.

Observations have also been made on the feeding of nestlings by the parent birds. The appetite of the young is truly prodigious, and every few minutes throughout the day one or other of the parent birds returns to the nest with food, which is generally of the nature of an insect such as a caterpillar, fly or beetle. Many fruit-eating birds feed their young solely on insect-food, and thus certain birds, which to a casual observer might be regarded as wholly harmful to the farmer, have been instrumental during a considerable portion of the year in protecting the crops from being over-run with insect vermin.

It may safely be asserted that bird-life taken as a whole is of the utmost economic value to the farmer, and in his own interest it behoves him to encourage it on his land.

Children with their traps and youths with catapults and air-guns often work destruction on the farmer's best friends, and every possible means should be taken to prevent this waste which may lead to a presence of birds.

Birds, in fact, act as a very efficient police force which is never off duty, but is ever searching for insects on the leaves of plants and for destructive grubs at the roots.

There is no doubt that the agriculturist is only beginning to realize the great importance of birds; and through hasty observation he has often been an active agent in reducing his crop by the destruction of birds which were apparently doing mischief. Birds of various kinds (Nightingales have been blamed) have been seen to uproot young plants, and they have on this account been summarily condemned and shot. These birds are searching for destructive beetles and other grubs at the roots of the plants, and they possess the remarkable faculty of locating such grubs. The young plant may apparently look healthy, but the bird in some unexplained manner discovers that there is a grub at the roots, and the loss of the plant is more than compensated for by the grub being removed and eaten by the bird.

In many districts there is a great paucity of bird-life, and this is not wholly due to the direct killing by the occupiers of the land. The scarcity is largely due to man's indirect influence. The lack of cover and the widespread bush fires are very prejudicial to bird-life. In European close-settled countries the agricultural land is covered with a regular net-work of more or less wide hedge rows, along which trees are very frequently scattered. Such hedge rows form admirable cover for birds, and to their presence the relative abundance of bird-life, in districts where the human population is relatively dense, is very largely due.

Farmers in this country would do well to consider carefully the needs of the birds. Strips of the bush should be especially reserved as cover, and where bush is scarce it would pay to plant strips of native trees and shrubs: but, of course, care would have to be exercised that the plantations should be placed in such situations as would permit their proper growth. There can be no doubt that clearing the bush to form agricultural land can soon be overdone, and on many farms there is practically no cover, and scarcity of the more valuable birds is the result. The planted belts would have to be sufficiently wide to enable them to resist the grass fires which are so general in Natal and other parts of South Africa.

The advisability of burning the grass is, however, extremely doubtful, and Professor Bews has shown in a recent number of the "Annals of the National Museum" that grass burning leads to a deterioration of the veld and the growth of the coarser and less valuable species; but this is scarcely the place to combat a practice which is so largely followed.

We will now pass in review a few of the more important birds which possess a high economic value to the agriculturist, but it must be remembered that many birds not mentioned are nevertheless of great value, and that, speaking generally, the very great majority of birds perform an invaluable function which far outweighs the value of the grain or fruit which some may consume at certain seasons of the year. In orchards when the fruit is ripening and in newly sown land it would undoubtedly pay the farmer to employ a few natives to frighten away the birds rather than to destroy them. In the majority of cases fruit-eating birds are only destructive to the fruit for a comparatively limited period, while during the remainder of the year their presence is in every way beneficial.

The owls are extremely valuable birds to the farmer, they feed on mice, moles, rats of all kinds, and on insects. They seldom attack chicken or other birds. The loss to the farmer caused by rats and mice, both in the granary and on the field is sometimes exceedingly great. Small mammals are the favourite food of the larger owls, and on no account should these birds be shot. The best known of the owls are the barn owl, the grass owl, and the eagle owls which have tufts of feathers on each side of the head, and are sometimes called eared owls.

Game birds generally, such as quails, partridges, pigeons, ducks, guinea-fowls, etc., are all of the greatest value. Messrs. A. Haagner and R. H. Ivy,

in their "Sketches of South African Bird-life," quote Mr. Thomson, of the former Transvaal Agricultural Department, as saying that not only do they devour mature locusts, but they scratch up and eat the eggs, Termites (Duck Ants), and their insects are devoured in large numbers. They are also useful in eating weed-seeds in large quantities. The reckless shooting of game birds is greatly to be deprecated by all agriculturists; they are of far more use alive than in swelling the bag of the sportsman.

All woodpeckers are of very special value. They build in decayed tree trunks, and throughout the day they search for insects hiding in the crevices of the bark of trees. Such insects are often most injurious to the growth of the tree, and every possible encouragement to these birds should be afforded by all orchardists and foresters.

The buntings, wagtails, warblers, chats, flycatchers, cuckoo-shrikes, and swifts are all true insect-eating birds and should be carefully preserved.

The nightjars or goatsuckers (Gie-me-a-bit) also deserve special mention. They are owl-like birds of medium size and possess an enormous gape to the mouth. They fly very silently in the dusk of the evening and feed on flying insects, such as mosquitoes, small moths, etc.

The so-called seed-eaters which include such birds as the Grassbirds and Canaries are also of value. They subsist chiefly on weed-seeds and insects, and the result of their presence being a considerable reduction in the number of weed-seeds cannot but be of value to all cultivators.

We have now seen that birds constitute a most valuable protective force against the inroads of destructive creatures such as snakes, rats, mice, moles, insects of all kinds, ticks, wireworms, etc., while many of the seed-eating birds subsist almost entirely on the seeds of troublesome weeds.

To protect birds in the farmers' interest, and to preserve from extinction some of the most exquisite creatures on earth, a Plumage Bill has been recently introduced in the British Parliament.

It is undoubtedly high time that the ruthless destruction of plumage birds for the supply of the Milliner should be ended by all civilized countries, since many of the more beautiful species of humming-birds, birds-of-paradise, etc., are nearing extinction through the wholesale destruction by collectors.

In conclusion it may be said that, from a purely practical aspect, it behoves all stock farmers, agriculturists and gardeners to take active steps to encourage bird-life; and much more may be accomplished by providing adequate strips of bush for cover, and by resolutely preventing the killing of the birds.

THE MANUFACTURE OF SUGAR:
THE MODERN METHOD *vs.* THE OLD.

CLEVE W. HINES.

There is no industry in the Philippine Islands possessing greater future possibilities than that of cane sugar. Every advantage is offered in the way of rich soils, a tropical climate with a rainy season during the main growing period, and a dry season during a good part of the harvest period.

The industry might, however, be said to be only in its infancy. While there are numerous small antiquated mills scattered over the islands, but few strictly modern mills are found in operation to-day. Several, however, with efficient crushing plants are doing excellent work, and one under construction, the Calamba factory, will be equal to the modern factories of Hawaii and Louisiana.

A number of attempts have been made to modernize some of the native factories by the addition of improved crushing apparatus, boiling plants, and occasionally centrifugals, each of which is a step in the right direction.

Crushing plants are found in the various sugar houses with results ranging from 55 to 84 per cent. juice on cane. One may readily realize what a great loss is encountered to the manufacturer if even as low an extraction as 65 per cent. is attained. A typical example will illustrate this. Here 650 kilos of juice are received from each ton of cane. This juice with a sucrose of 15·2 per cent. gives 98·8 kilos of sucrose in juice recovered from each ton of cane. A modern mill with an extraction of 84 per cent. will give 840 pounds of juice with a sucrose of 15·1 per cent. (The last juice extracted from cane gives a lower sucrose and purity than the first.) This will give 126·8 pounds of sucrose from each ton. This difference will amount to 29·1 kilos of 96° test sugar valued at P 3·48.

The bagasse from the latter mill will have a much higher fuel value than the former because of the lower moisture content. One kilo of bagasse with a moisture content of 56 per cent. has a heat value of 65, 491 B. t. u., while a kilo with a moisture content of 44 per cent. has a value of 90,882 B. t. u. These seem like enormous losses encountered by some of the smaller sugar houses, yet they have little comparison with many of the other losses throughout the plant.

After the juice leaves the rolls it is strained to remove any particles of bagasse and other foreign matter.

SULPHURING OF THE JUICE.

The juice is now subjected to a sulphuring process which has a fourfold purpose. It removes some impurities, increases the acidity of the juice so that a greater quantity of lime may be added with precipitates impurities not removed by the sulphur, decolorizes or bleaches the organic nonsugars, and acts, to a certain extent, as a preservative. Juice should always be sulphured in the cold for two reasons: First, sulphurous acid at high temperatures would destroy by inversion an undesirable quantity of sugar; secondly, some sulphuric acid is likely to be formed which is much more active than the former. This sulphuric acid is the dangerous chemical in sugar-house work, but is only formed when high temperatures are used during sulphuring. The pipe carrying the sulphur fumes from the burner should be surrounded by a larger pipe filled with cool water to prevent the fumes from leaving at too high a temperature.

It may very readily be seen what an important role this sulphuring process plays in sugar-house work, and yet it is astonishing what little attention it oftentimes receives. Too many sugar houses are run without a definite knowledge of what is going on in each process of the work.

THE LIMING PROCESS.

Immediately following the sulphuring of the juice comes the liming process. This requires even more skill than the former. In many factories expert clarifying men do nothing but attend to this part of the work.

The first action of the lime is to neutralize the organic and inorganic acids; it then coagulates some albumins and albuminoids, throws down insoluble lime salts in the form of sulphates, phosphates and carbonates, and the bases, iron and aluminum. These heavier compounds act as mechanical precipitants bringing down with them other impurities. These are removed at the bottom of the settling tanks and are sent to the filter process. The lighter substances including such material as fibre, wax, etc., float to the top in the form of a flocculant precipitate and are removed in the form of a "blanket."

METHODS OF JUDGING THE CORRECT AMOUNT OF LIME.

There are two methods of judging the correct amount of lime to use. First, the chemical method as follows : 10 cubic centimeters of the juice are titrated against a standard acid using phenolphthale in or litmus as an indicator. It is not safe to lime beyond the neutral point. It is usually best to leave the juice slightly acid (about 0·2 cubic centimeter or 0·3 cubic centimeter in order to be on the safe side). The second method is one where the experienced operator judges by the colour of the juice, the rate of precipitation, etc.

The former method gives more accurate results and can be absolutely relied upon.

EVIL EFFECTS OF OVERLIMING.

As stated before it is never safe to carry liming beyond neutrality. At this point all the precipitable impurities are removed and any excess of lime added will result in the destruction of the reducing sugars and the formation of soluble lime compounds of organic acids which impart a very dark colour to the juice and will later decompose into acid substances causing inversion of the sucrose.

The lime salts also increase the viscosity of the massecuites thus retarding evaporation and crystallization. These dark-coloured massecuites can only give a low yield of an inferior sugar with an excessive amount of molasses. These lime salts may be partly removed by the use of phosphoric acid. While this may improve conditions to a certain extent it does not remove the glucinic acid which has been liberated and must continue to impart the dark colour.

A factory recently visited had a good mill and fairly modern equipment throughout the house. The cane received was of the very finest type of Hawaiian and native mixed. The juice was in good condition until it reached the liming tank. Here it was limed to 0·4 cubic centimeter alkalinity and heated to 100° C. It immediately turned dark and exhibited all the evil effects of an overlimed juice. Phosphoric acid was then added until an acidity of from 0·7 cubic centimeter to 1 cubic centimeter was reached. During the process of evaporation these lime salts continued to decompose, increasing the already acid juice and causing a destruction of sucrose by inversion which gave an excessive amount of molasses that was of necessity turned out with a high purity since the large amount of invert sugar and lime salts prevented the crystallization of the sucrose. This final molasses with a purity of 52 was being sold for 16 centavos per gallon which was a small fraction of its sucrose value, were it possible to recover same. A slight change in the sulphuring of this plant with a reduction of the liming to 0·3 cubic centimeter acidity gave a beautiful straw coloured juice which precipitated well and gave a clear juice with a minimum of lime salts for the evaporators. The massecuite resulting from this juice was equal to many the writer has seen in Louisiana and Porto Rico where a much more elaborate process was used. The sugar was very readily washed to a yellow clarified grade and placed directly on the market for immediate consumption.—Philippine Agricultural Review.

THE SOURCES OF THE NITROGEN OF VEGETATION.

The results of the whole inquiry carried out by Mr. J. B. Lawes, Dr. Gilbert, and Dr. Pugh on the sources of the nitrogen of vegetation, etc., may be very briefly enumerated as follows :—

The yield of Nitrogen in the vegetation over a given area of land, within a given time, especially in the case of Leguminous crops, is not satisfactorily

explained by reference to the hitherto quantitatively determined periodical supplies of combined Nitrogen.

Numerous experiments have been made by M. Boussingault, from which he concludes that free or uncombined Nitrogen is not a direct source of the Nitrogen of vegetation. M. G. Ville, on the other hand, concludes, from his results, that free Nitrogen may be a source of a considerable proportion of the Nitrogen of growing plants. The views, or explanations, or other experiments, on this disputed point, are various and inconclusive.

It was found that the conditions of growth adopted in our own experiments, on the question of the assimilation of free Nitrogen by plants, were consistent with the healthy development of various Graminaceous plants, but not so much so for that of the Leguminous plants experimented upon.

From the results of various investigations, as well as from other considerations, we think it may be concluded that, under the circumstances of our experiments on the question of the assimilation of free Nitrogen by plants, there would not be any supply to them of an unaccounted quantity of combined Nitrogen, due either to the formation of oxygen-compounds of it under the influence of ozone, or that of ammonia under the influence of nascent hydrogen.

We have found that free Nitrogen is given off in the decomposition of Nitrogenous organic matter, under certain circumstances. But considering the circumstances of such evolution, and those to which the nitrogenous organic matter necessarily involved in experiments on the question of the assimilation of free Nitrogen by plants is subjected, it may, we think, be concluded that there would be no loss of combined Nitrogen from this cause in such an experiment, excepting in certain cases, when it might be presupposed.

Our experimental evidence, so far as it goes, does not favour the supposition that there would be any loss of combined Nitrogen in our experiments on the question of assimilation, due to the evolution of free Nitrogen from the Nitrogenous constituents of the plants during growth.

In numerous experiments with Gaminaceous plants, grown both with and without a supply of combined Nitrogen beyond that contained in the seed sown, in which there was great variation in the amount of combined nitrogen involved, and a wide range in the conditions, character, and amount of growth, we have in no case found any evidence of an assimilation of free or uncombined Nitrogen.

In our experiments with Leguminous plants the growth was less satisfactory ; and the range of conditions possibly favourable for assimilation of free Nitrogen was, therefore, more limited. But the results recorded with these plants, so far as they go, do not indicate any assimilation of free Nitrogen. Since, however, in practice, Leguminous crops assimilate from some source, so very much more Nitrogen than Graminaceous ones, under ostensibly equal circumstances of supply of combined Nitrogen, it is desirable that the evidence of further experiments with these plants, under conditions of more healthy growth, should be obtained.

Results obtained with some other plants are in the same sense as those obtained with Graminaceæ and Leguminosæ, in regard to the question of the assimilation of free Nitrogen.

In view of the evidence afforded of the non-assimilation of free Nitrogen by plants under the wide range of circumstances provided in the experiments, it is decided that the several actual or possible sources of combined Nitrogen to plants should be more fully investigated, both qualitatively and quantitatively.

If it be established that the processes of vegetation do not bring free Nitrogen into combination, it still remains not very obvious to what actions a large proportion of the existing combined Nitrogen may be attributed.

THE DEVELOPMENT OF THE LOCAL COCONUT INDUSTRY.

In a recent publication entitled "All about Coconuts" by Belfort and Hoyer the writers remark that "at the present moment there is throughout Ceylon a great scarcity of land suitable for successful Coconut Growing."

This is not exactly the case inasmuch as there is still a fairly extensive area awaiting exploitation in regions where by adopting up-to-date methods of cultivation it is possible to secure very good yields.

Last month the purchase of a large tract in the Puttalam district was announced and this only goes to prove that experienced men are not afraid to venture into our drier parts. Anyone who visited that district during the last dry spell would have noticed the successful stand made by the palms under proper tillage and their healthy and prolific appearance.

It is only the traveller who penetrates into the remoter parts of the Island that has the opportunity of seeing the possibilities of extending coconut cultivation. The vigorous growth of the palm as seen from the Madampe-Godakawela road in the Sabragamuwa Province would come as a surprise to those who generally associate coconut cultivation with certain well known districts, and do not know that there is a good deal of land in the Island far from recognised coconut centres awaiting the enterprising planter.

Another phase of the development of coconut planting in the Island is intensive (as opposed to extensive) cultivation and the higher yields that are being secured by planters who believe in good tillage combined with manuring.

With liberal treatment a yield of 80 to 85 nuts per tree per annum over large areas is becoming common. The accompanying illustration reproduces one of a series of photographs taken on Kandehena Estate in the Veyangoda district belonging to Mr. Solomon Seneviratne. The tree which is 30 years old and has been systematically manured during the past few years is not a specially selected one; for indeed the whole estate is a model of careful cultivation and generous treatment. The illustration will give an idea of the high standard to which the palms of this favoured district could be brought under intelligent management.

C. D

EXTERMINATING RATS.

A report from M de Kruyff of the Dutch Agricultural Bureau at Buitenzorg, Java, points the way to real success in rat killing. He tried the modern method of giving a contagious disease to one rat in the hope that all would die. This proved useless. Finally, De Kruyff hit upon a novel use of carbon bisulphide. All visible rat holes were first stopped with earth to ascertain which holes were inhabited, for the inhabited holes were found reopened on the following day. Half a tea-spoonful of carbon bisulphide was poured in each of these holes and, after waiting a few seconds to allow the liquid to evaporate, the mixture of vapour and air was ignited. The resulting small explosion filled the hole with poisonous gases and killed all the rats almost instantly.—Scientific American.

COCONUTS AT VEYANGODA

MAIZE SUGAR.

Mr. O. W. Barrett, the versatile horticulturist of the Philippine Bureau of Agriculture, takes a hopeful view of the possibility of maize becoming a serious rival of cane in the sugar market, and advises Philippine planters to experiment along this line, notwithstanding the unsatisfactory results of experiments already conducted in the United States. The maize plant, when deprived of the ears at the time starch is being deposited in the kernels, i.e., when the seed is "in the milk," develops a remarkable saccharose, or rather glucose content. Thus, the agricultural chemist of the Rhodesian government finds as high as 12½ to 14 per cent. of sugar and about 1 per cent. of glucose in the decobbed maize stalks in his experiments, which is above the average yield from sugar cane. Mr. Barrett quotes the opinions of experts that maize "will be, through its wonderful variability under the hybridizer's hands and its adaptation to man's varied needs, the greatest crop of the future."—Scientific American.

RADIUM IN AGRICULTURE.

According to recent experiments in Europe it appears that radium is instrumental in preventing diseases of plants, whence is likely to arise a new application of this interesting element in agriculture. For several years workers in agronomic science have been experimenting upon the effect of radium upon vegetation by mixing radio-active substances with the usual fertilisers. The numerous results obtained in this work show that most plants, either grain or flower, are remarkably stimulated and give a better yield both in size and quality, this being often seen in the fine and healthy colour of the green plants or leaves. Under these conditions it is not surprising that the same plants are in better condition to resist attacks from various sources of disease such as cause so much damage to crops, especially diseases known as cryptogamic, which arise from spores or mold. It seems that radium is to act as a preventive for such diseases as wheat rust, rotting of potatoes, grape vine mildew and many others which cause such detriment to agriculture. Such a result is only to be expected from what we know as to vital phenomen in general, and among others as concerns the human body, for all influences that tend to reduce the vitality of the system are likely to leave it a prey to harmful outside influences and infections. Such results in the application of radium in agriculture are likely to be far-reaching.—Scientific American.

RESEARCH IN BENGAL.

Mr. Meggit's work on sugarcane has so far been very successful and, as a result of the soil treatment adopted, the outturn of cane has risen during the last five years from 10 to 30 tons per acre. The use of lime and bone-meal has had a remarkable effect on the fertility of the soil of the Dacca farm, paticularly in the case of rabi crops, and it is hoped that the experiments, which will be continued for the full period of six years, as originally contemplated, will yield definite results in regard to the residual value of manuring over a number of years. Green manuring experiments have also been continued, and so far the cow pea have proved itself the most useful plant for this purpose. Mr. Hector's important botanical work in connection

with the rice crop has shown that natural cross fertilization takes place to a much greater extent than was at first supposed, and a few successful crosses have been obtained. Special attention is rightly being paid to the higher yielding varieties. A large amount of time has been devoted to the study of the *ufra* disease of paddy which has appeared on a considerable scale in some of the deltaic districts of Eastern Bengal, and a full account of the work up to date is being published. It has been established that the disease is caused by an eelworm of the genus *Tylenchus*, allied to worms which cause well-known diseases of other cereals. The best remedy, so far discovered, appears to be the destruction of the worm, when in passive condition after harvest, by burning the stubble. An attempt is being made to work out a feasible scheme for dealing with the evil, but the problem which is of the utmost importance to the welfare of the province is one of much difficulty. —Indian Agriculturist.

LICORICE.

A very considerable part of the licorice root used in America is from marshy plains in Turkey and Russia.

This root is not cultivated, but grows wild in large quantities, generally in great stretches of open ground where the soil is more or less damp. It is regarded as a serious pest and greatly interferes with cultivation. Much land is abandoned to it, while some is ploughed and sown notwithstanding its presence. It is a perennial herb of the genus *Glycyrrhiza* of the bean family. The licorice of commerce is obtained by evaporating an infusion of the sliced roots. This solidified substance is used for flavouring confectionery and beer as well as entering into the make-up of most of the brands of tobacco.

The growth above ground of the plant is about two feet, while the root is about as deep beneath the soil. The land in Syria from which the root is gathered is leased from the owners, the condition, as far as lands that are cultivated, being that the digging out of the licorice root must cease when the time comes for planting the cereal crops. The result is, as far as these lands are concerned, that the getting out of the roots must be done quickly as soon as the rains, which begin in October generally, have somewhat moistened the ground, as it would be very difficult to do the digging in the long dry summer.

The root is piled in great stacks, and when the digging season is over a watchman takes charge, and the root remains thus stacked through the winter and the following summer, when it becomes quite dry and is ready for transportation to the coast. Great care has to be exercised that the stacks do not heat or mildew.

The Aleppo district gathers and exports on an average an aggregate of 8,000 tons annually of dry licorice root, while Bagdad yields about 6,000 tons, Antioch 4,000 tons, and Damascus 500 tons.

The pulp is pressed, with American ingenuity, into boards which are used in cabinet work and which are said to make up into novel and handsome articles.—Scientific American.

SORGHUM.

Sorghum (*Sorghum vulgare*) is a valuable food product of the millet order. Forms of it are known as Kaffir-corn and Dura. Six to eight pounds of seed are sufficient to sow an acre which should yield 500 lb. at least.

In parts of Africa sorghum forms the staple diet of the natives. It can be either boiled and eaten in the same way as rice, or ground into a fine flour which is capable of being made into excellent and nutritious bread. The advantage, from the native's point of view, that this grain possesses over maize is that it entails none of the slow hand labour of detaching the grains from the cob, and that it is very easy to grind, as compared with the hard-grained maize. Furthermore it is not as heating as maize.

It is also largely used, when fermented, as beer which if intoxicating, leaves no harmful results behind, and is nutritious.

It is exported to Europe for distilling the very fine alcohol obtained from the grain.

The leaves form a good fodder for cattle and the grain is excellent for horses and donkeys.

Other varieties of sorghum are grown for brooms and for sugar extraction.

D. S. C.

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BALSAM OF PERU.

The fragrant balsam imported into the United States as balsam of Peru is produced by a tree known botanically as *Myroxylon pereiræ* Klotzsch. This tree is a native of the Republic of San Salvador on the Pacific Coast of Central America known as the Balsam Coast, a tract of land which formerly belonged to Gautemala. The Coast was so named because originally balsam was the only article that was collected and shipped away from that region. The tree is found growing wild only along the west coast and in some localities it often occurs in dense forests. The balsam was long erroneously supposed to be a product of South America. In the period of Spanish rule, and by the commercial regulations then existing relative to the fruits of the coast, it was usually sent by the merchants here to Callao, Peru, and from there shipped to Spain, which accounts for the name of balsam of Peru, because it was considered indigenous to that region. The real place of its origin was known only to a few merchants.

At the present time balsam is shipped direct from points along the Balsam Coast which extends from Acajutla to La Libertad. The chief wealth of this coast is balsam and the trees yielding it are very numerous and apparently limited to one species, for in no other part of the coast, seemingly identical in soil and climate, are natural grown trees met with. Latterly the tree was introduced into tropical Africa and into the East Indies. The balsam tree is said to thrive very well in Kamerun in West Africa. A number of small experimental plantations have been started, and it is believed that a very profitable balsam industry will soon be developed there. It was planted as early as 1861 in Ceylon, and with complete success. A considerable quantity is yearly collected from trees which were planted near Calcutta, India, and the Central America balsam trade is now receiving some competition from these points.

The manner employed by the Indians of the Balsam Coast in collecting the resin is very crude. Incisions of from nine to ten inches long and about two inches wide are made in the bark of the trunk. The areas from which the bark has been removed are wrapped with rags, and the tree being previously heated by a brisk fire around it, or by means of torches, exudes a gummy substance which is absorbed by the rags that are allowed to remain on the naked wood for a few days, when they are removed and placed in a pot of boiling water, which separates the gum from the rags. They are taken out before the water cools, and the resin, which has a greater density than water sinks to the bottom and is collected after the water is poured off. The rags are removed from the water while they are still hot and submitted at once to heavy pressure for the purpose of obtaining the balsam still attached to them.

The balsam is imported in large earthern-ware pots of a pearshaped form partly covered with basket work, or in tin canisters. The balsam is a thick treacly-looking liquid, with a fragrant aromatic odour and taste. It is used in medicine as a stimulant, and also for making spills for lighting candles in churches and for torches.

The amount and value of imports of balsam of Peru from Central America during the past seven years have been as follows:—

Year.	Amount Pounds.	Value.
1905	29,835	$17,114
1906	15,747	10,848
1907	13,303	11,817
1908	28,021	26,171
1909	25,843	24,217
1910	50,363	49,132
1911	37,910	47,840

The tree, which yields the commercial balsam, is about 45 feet in height and from 12 to 18 inches in diameter at the base. The trunk often grows to the height of from 6 to 9 feet before it puts forth any branches. The wood is of a close grain, handsomely veined, nearly of a mahogany colour, but redder. It has a very agreeable odor, which it retains for a long time and takes an excellent polish. Balsam wood is highly esteemed for cabinet work, but is rarely to be obtained, since the trees are seldom felled for the wood they yield.—Scientific American.

THE RIDDLE OF SPECIES.

Dr. Lotsy's thesis is that new species arise by the crossing of species. Though the thesis is not new, the arguments which the author advances in its support are both novel and weighty. Briefly these arguments are as follows: A species is a thing of infinite variety. It is an assemblage of forms which may be arranged into a larger or smaller number of lesser groups—the petites èspeces of Jordan. If the sorting process be carried far enough the species may be separated into a number of microspecies, each of which is unique and immutable. A true microspecies might be grown for ever and anywhere, and it would first and last and always to itself be true.

If, however, one microspecies with one set of characters be mated with another possessing a different set of characters, an unstable hybrid is produced.

The hybrid characters of this first generation plant or animal are dealt out among its offspring in all manner of combinations. The several characters of the parents are recombined in new and varied ways in the offspring. Some of these combinations are such that the forms which possess them breed true. They are petites èspeces or genotypes, and, in so far as they differ from one another and from the parental forms, they are new microspecies. If the two parents belong to different species the assemblage of microspecies which segregate in the second or later generation constitute a new species in the ordinary sense of that heavy-laden word.

To do justice to the argument and to the wealth of illustration which Dr. Lotsy brought forward in its support is not possible within the limits of space at our disposal. We will, therefore, confine ourselves to examining what must be regarded as the fundamental postulate on which the argument is based. This postulate affirms that a genotype or true microspecies is, like the laws of the Medes and Persians, unalterable. Like the germ plasm of Weissmann, a geno type cannot change. It is the unit of life. Circumstance; climate, may play upon the individual and may make it tall or short, fleshy or meagre, but such passing influences have no lasting effect, and the progeny of the genotype shows no trace of the changes which circumstances begat in the parent.

This is hardly a proposition to which those who are best informed will neither assent nor object. They will ask for proof. This proof Dr. Lotsy offers in the results of Johannsen's famous experiments on the inheritance of size and weight of beans. As is now well known, Johannsen discovered that it is possible to sort out from a race of beans a number of pure lines. In each pure line the seeds have a certain range of weight and size, and for each pure line that range is fixed, so that although seeds are chosen from either end of the range—a large seed and a small seed, for example—the range of the size in the seeds which they produce is the same in the produce of the small and of the large seed and identical with that of the pure line from which the seed was selected; or, expressed axiomatically, all the members of a pure line give rise to identical offspring. Selection in the seedman's sense means, therefore, the picking out of those pure lines which best serve his purpose.

We are not prepared to assert that DR. LOTSY is wrong in ascribing this undeviating permanence to the germinal factors on which a plant's manifest character depend. We are inclined to think, however, that DR. LOTSY ascribes to these factors a too rigid unchangeableness. The factors which determine characters must grow. Therefore, it is possible that in some circumstances the rate of growth of a factor may be so increased that a germ cell may receive "two factorial doses" instead of one, and this doubling of a factor may be expressed in the plant by a "new" character—a giant, a brighter flower, or even a change of form. If this be proved to occur, DR. LOTSY'S conclusion that species originate solely by crossing must be regarded as untenable; but even so, the author will have performed a notable service in compelling the wandering or reluctant attentions of biologists to the greatest—or almost the greatest—of biological problems.—GARDENERS' CHRONICLE.

SCHOOL GARDENING.*

The object which MR. BREWER has in view in writing this book is expressed succinctly in the introduction which is written by the RT. HON. HENRY HOBHOUSE. This object is to show how the school garden may be used so as to give a less "bookish" form of education than that now prevalent. To this end the author is at pains to indicate how lessons in many subjects—arithmetic, drawing, mensuration, etc.—may be made more real by relating them with the work of the school garden. In accordance with this ruling idea MR. BREWER recommends that lessons in woodwork—now given in many schools—should take the form of exercises in the making of the simpler garden implements.

With these views we are in fullest sympathy, but we must take serious exception to the author's assertion that "*A schoolmaster should not mind if he is not an expert at gardening;* he should be an expert at teaching, and it is the teaching that is the thing." The fallacy underlying the statement italicised is responsible for half the evil in modern education. The cry goes up for a change from the old book subjects to more real subjects, and teachers ignorant of these subjects are obliged to teach them. The result is deplorable, and chiefly in this, that in the ignorant hands the "real" subjects soon became as unreal as those which they have displaced.

It is true that a teacher in a school garden need not know the practice of hot-house cultivation of Grapes and Pines, nor need he be conversant with the intricacies of Orchid hybrids; but if he be not an expert in school gardening he will be bound to fail. As FALSTAFF exclaimed: "I am not only witty in myself, but a cause of wit in others." For a real teacher in any subject must be able to declare: "I can not only tell my scholars how to do this thing, but I can do it." This fundamental fallacy excepted, we are in general agreement with Mr. BREWER'S thesis. His purpose is to make the scholars use their eyes and hands and wits, and he succeeds in demonstrating that this may be achieved by making full use of the school garden as a school teaching instrument.

Teachers who find themselves in charge of school gardens and who wish to make the fullest use of them will find in MR. BREWER'S book much useful help. We like particularly the introduction of simple experiments—e.g., in seed sowing—into the ordinary school work, for among too many people there still lingers the idea that an experiment is a mode of mystification instead of a method of getting an answer to a precise question. The help which such teachers may derive is both direct and indirect: not only may they adopt MR. BREWER'S suggestions, but they will be led themselves to conceive of others which they can put into practice in the lessons in the school garden.—GARDENERS' CHRONICLE.

* *Educational School Gardening and Handiwork.* By G. W. S. BREWER.

CARBON DIOXIDE AND SEED VITALITY.

The seeds of the commonalty of plants are docile things. Given but a modicum of attention and they practise straightway the magic of their growth. Yet, as we all know, there are recalcitrants among the commonwealth of plants—some refusing to germinate unless they receive special attention, others maintaining unimpaired their powers of development even though they be treated most neglectfully. But whether difficult or easy in their response to the cultivator's cozening, all the seeds of cultivated plants have this in common, that if not sown soon after they are ripe their vitality fades by slow degrees, until after a briefer or longer period of decline it is lost altogether. In sharp contrast with this brief temporal hold on life is the endurance of the seeds of various weeds. For the seeds of Charlock, of Foxglove, and certain other wild plants time, as it were, stands still, and long years after chance has buried them in the ground these seeds may spring up again and minister to the wonder of the observant and the credulity of the casual looker on. The seedsman accepts the annual loss among his seed stores as incidental to his trade. After making the best provision he may for the storage of his seed he bows to the inevitable, discards his stock of old seed of low germination capacity, and looks to each recurrent harvest to make good the loss. He knows that deterioration goes on more rapidly if the seed be that of a bad harvest, and he is aware of the fact that this deterioration may be delayed—at the expense of rapidity of germination—if the seed be dried by artificial means. To the man of science it is evident that large problems lurk behind these phenomena, and numerous attempts have been made to discover the causes of deterioration and of longevity of seeds. Until the other day these attempts had met with but scant success ; but now a new worker has appeared in the field, and his discoveries, announced at the meeting of the Royal Society on March 8, bid fair to clear up some of the mystery which attaches to the problem of the life of the seed.

Mr. Kidd, who has made this important contribution to our knowledge, has established the facts that if seeds be kept in an atmosphere containing from 20 to 30 per cent. of carbon dioxide their germination capacity may be held up indefinitely, and that they are none the worse for their enforced rest. When removed from the air charged with carbon dioxide and placed under ordinary conditions the seeds germinate at once. If this discovery be found to apply generally to the seeds of horticultural and agricultural plants it will prove of very considerable practical value. By Mr. Kidd's method, which would appear to be of very simple application on a commercial scale, the seedsman will be able to arrest the gradual deterioration of his seeds, and, if he chooses, hold over stocks from the harvest of good years to supplement those of leaner harvests. The planter will be able to obtain seeds of Para Rubber (*Hevea brasiliensis*), which, unlike those which he is apt now to receive, may be guaranteed of high germination capacity. The traveller who includes in his kit a small cylinder of liquid carbon dioxide may succeed better than in the past in bringing home living seeds of the novelties which he has collected on his journeys. Indeed, should this simple method prove generally efficacious we may before long have seeds on the market as we have vintage wines guaranteed as the produce of a great year. To speculate thus is, however, to outrun the warrant given us by Mr. Kidd's brief abstract of his work. What is clear is that we possess in carbon dioxide, properly applied, a means of arresting the slow loss of vitality which seeds suffer when exposed to ordinary conditions. No less interesting is the further discovery that in one case at all events (*Brassica alba*) seeds which have been treated with carbon dioxide remain dormant even when put in conditions of air, moisture, and temperature which favour germination. Such seeds require special

treatment before they may be awakened from the torpor in which they have been plunged. To induce them to germinate, the seed coat must be removed, or the intact seeds must be dried thoroughly and re-wetted.

This remarkable behaviour of the seeds of *Brassica alba* bears directly on the phenomenon of delayed germination manifested by the seeds of Charlock, Foxglove, and other wild plants; for it suggests that this delayed germination is due to a similar cause, namely, the "sealing" of the seed coat as a result of exposure to carbon dioxide. The effect of this treatment appears to be that the seed coat becomes less penetrable by oxygen, and so the seed, unquickened by oxygen, remains dormant.

Mr. Kidd has shown by means of an ingenious experiment that seeds lying in the ground may be induced to remain dormant. Thus if a mass of green vegetable matter be buried deeply in the earth, and seeds be planted in soil over it, germination of the seeds is prevented by the carbon dioxide given off from the decaying plant remains.

We shall look forward with great interest to the publication of Mr. Kidd's researches, for we are confident that they supply a clue to the understanding of many obscure phenomena presented by the alternating states of rest and activity which occur among plants.—Gardeners' Chronicle.

GARDENS FOR THE POOR.

LEOPOLD KLATSCHER.

Mme. Felicie Hervieu, of Sedan, was in the habit of giving financial assistance to a family of ten, and yet they were always in want. The benefactress was struck by this fact, and at last said to the head of the family, "You must be saved from this plight. Instead of giving you continual temporary help I shall put 6 francs in the Savings Bank for you every month for one year, on the condition that you add 3 francs to it." It was difficult but it was managed, and thus in a year's time 108 francs were saved. "Now you must employ the money advantageously," said the lady. "Rent a garden in your free time with your children." Averse to work and accustomed to help, the people seemed unable to find a garden, but Mme. Hervieu soon found one, and urged her protégés to work. At first unwilling, they soon took pleasure in it, and, at the end of a few months, found themselves able to obtain from their plot a large proportion of their food, as well as earn a fair sum of money by the sale of vegetables.

This was the beginning, about twenty years ago, of the present extensive charitable movement in France to institute gardens for the poor. Mme. Hervieu's success induced a number of ladies in Sedan to lay by 60 francs each—instead of giving small alms in the streets—to enable them to supply garden plots for cultivation by the poor, and thus to fight against the professional begging so widely practised in the town. At first some 1,600 square yards were rented and divided between twenty-one families; seeds, manure and implements were placed at their disposal. This cost 531 francs during the first year—a sum which would have amounted to only 0·30 francs per head monthly if it had been given in coin, whereas in the form of garden plots it supplied 145 persons with a considerable part of their nourishment.

Mme. Hervieu then founded a society, "L'œuvre de la reconstitution de la famille," to facilitate the systematic diffusion of her ideas. By this society large families were allotted garden plots of from about 400-800 square yards each, according to the number of children, and also implements, manure and seeds. In 1895 a fresh venture was made by entrusting a similar plot of garden land to a set of lads from 15 to 16 years of age for

their joint cultivation, on the condition that each lad should pay one franc from his profits monthly into the Savings Bank. In the first year the net proceeds amounted to 50 francs a head, and in 1899 a further step was taken in granting plots on similar conditions to school children of eleven to twelve years. Thus in 1903 there were in Sedan 260 organised gardens for the poor, occupying an area of some 55 acres, and cultivated by 1,500 workers. In the whole of France there were in 1906 11,547 such gardens in 224 towns, which were contributing to the support of no fewer than 40,000 persons.

Father Volpette, a Catholic priest in St. Etienne, who learnt of the successful efforts of the Sedan ladies, followed the example, rented a field of 3½ acres for 200 francs, and divided it into plots of 470 square yards, which he assigned to 30 needy families. Later he rented more land, and other plots were given him gratuitously. By the end of the year, with an outlay of 350 francs, he had about 12 acres at his disposal, which were divided among 98 families (608 persons in all). Fencing, draining, implements, manure and seeds cost 3,050 francs. In spite of drought, the proceeds of the outlay of 3,400 francs amounted to about 6,000 francs by the market sale of vegetables, including potatoes—that is to say, to over 60 francs per family. In the following years expenses came to about 1,500 francs per annum, while the profits, even in bad harvests, have amounted to from 6,000 to 7,500 francs, and of course much more in good years. Father Volpette made four conditions with his protégés:—Diligent, daily cultivation; Sundays and church holidays strictly excluded; no under letting without an agreement; the avoidance of everything that could harm the good reputation of the allotment holders. I append an extract from Father Volpette's "Constitution":—

"Each combined group of gardens has its own board of directors. For this purpose every five families choose a representative for three years. All the representatives of a group form its board of directors, who have to decide upon all matters of common interest to the garden owners. They also determine the extent of outlay to be made in favour of the separate families from the capital of the group, and can refuse seeds if the land is insufficiently prepared, and even decree the expulsion of families with the ratification of the General Council. The latter possesses the following powers:—Final decision as to admittance or expulsion; decision as to the amount to be spent on each group of gardens; alterations of the regulations and by-laws; deliberation over the common interests of the groups."

Father Volpette's enterprise is not only distinguished by its "Constitution," but also by facilities in the way of dwelling-houses. One day an old, disabled miner drawing a small pension began to erect a very primitive dwelling on only 24 cubic metres upon his allotment. It was a rather curious cottage, but it answered the purpose, and served to induce others more skilled in building to follow suit. In order to cheapen the building materials Father Volpette founded a brick-yard that was able to sell at 3 francs the thousand. The bricks are of the best quality, and are mostly made by allotment holders temporarily unemployed. There are at present about 800 Volpette gardens, from which nearly 4,500 persons draw profits. There exists also a Raiffeisen Bank granting loans up to 500 francs, and defraying two-thirds of the cost of cottage-building for members able to furnish one-third from their own savings. In his Arbeitergärten, Schülergärten, Herr. W. von Klackstein mentions a remarkable experiment, without, however, naming the locality:—

"A French enterprise grants each garden contract for four years. The first year the allotment holder receives land, manure, seeds and plants free of charge, and in the three following years the Association only bears the

expense of the land rent, and from the fifth year onwards the garden-holder must pay a rent of 8 marks annually."

This excellent plan appears to have met with success all over France. Those disinclined for work learned to like regular activity, worked for themselves and finally became proud, in a good sense, of their independence Their life in the gardens, where they can eat with their families, makes them lose their former predilection for the public house. In course of time they become thrifty, their manners improve, and, in some instances, they become prosperous. It is indeed not surprising that statesmen should have endeavoured to obtain for these small gardens the advantages of the excellent Small Dwellings Act of 1886, which makes provision (at 2 per cent.) for loans from public funds and interdicts distraint upon the holdings. An Act for this purpose came into force in April, 1908.—Gardeners' Chronicle.

GROUNDNUTS.

The commercial importance of the peanut may be illustrated by the fact that the harvest of this product in America three years ago amounted to the sum of twelve million dollars as the money value of five millions of bushels—an output truly surprising, when one takes into consideration the fact that the peanut does not figure in the ordinary list of food-stuffs, and is only eaten on rare occasions. And yet, few persons have the smallest idea of its value, not only as an article of commerce, but as a food for farm stock.

The peanut (*arachis hypogea*) is known in various localities of the U. S. A. by the names of earthnut, groundnut, goober, and pindar. It is an annual plant, of a creeping and straggling habit, growing from 1 to 2 feet high, with angular and hairy shoots of a pale-green colour. It has a peculiar habit of perfecting its fruit under ground. As a matter of fact, the fruit has not the appearance of a nut. It ought more properly to be called a pea, the term " nut " having been given to it by the English-speaking people on account of the flavour, which is similar to that of a large number of true nuts. The flower, small and yellow, is borne at the end of a long calyxed stalk, like a peduncle, and the ovary is at the end. After the fall of the flower, the short and thick stalk which held the lower part of the flower lengthens itself downwards, penetrating several inches into the soil; and there the ovary begins to enlarge and develop into a wrinkled, slightly contorted pod of a pale yellow colour. This pod, depressed around the middle, contains from one to 3 beans. In the event of the ovary's not reaching the ground and penetrating it, a few hours after the fall of the flower, it withers and dies.

SOIL.

The soil best adapted for the cultivation of the peanut is one which is naturally sandy or marly, preferably of a light or grey colour. Dark soil, and such as contains a considerable amount of iron or other mineral, tends to stain the pod, thus making it less desirable from a commercial point of view. For other purposes, however, the stain on the pod are of little importance, since no loss is sustained in its value as a food for farm stock. In fact, a soil which contains a considerable amount of clay and lime produce pods of a large size, and at times a larger crop than the most friable soils. As a general rule, the pods are produced in larger quantities in a sandy or marly soil, with a clayey and dry subsoil; but they can be cultivated under different conditions. Hard and compact soils are not adapted to the cultivation owing to the fact that the " pegs " cannot penetrate through the surface.

CLIMATE.

The climatic conditions are, a long season free from frost. Light rainfalls during the period of growth, a lot of sunshine, and a high temperature. Spanish varieties come to maturity in 90 days; but they ought to be kept to ripen for 110 to 120 days.

Ploughing for sowing seed ought not to be as deep as that for maize in the same locality. From 5 to 6 inches should be sufficient. Deep ploughing might be resorted to in the case of a soil which has deficient drainage. After ploughing and a little before sowing, the ground ought to be harrowed, so as to prevent the loss of humidity. In sandy soils, which are almost free of ill weeds, it is possible to dispense almost entirely with ploughing, using a disc plough or a harrow only.

Under ordinary circumstances the land should be level; but where the drainage is imperfect, it is necessary to make low ridges on which to plant. This is desirable, especially during a season of excessive rain. Stable or farm manure ought not to be used as dressing, owing to the large number of seeds of various kinds which they contain. Commercial manure, however, can be used with advantage; although the soil adapted to the cultivation will not need it in large quantities. A commercial manure which has a percentage of 2 to 4 of nitrogen and from 5 to 7 of phosphoric acid in a form easily assimilated, and from 6 to 10 of potash, is the best, and should be applied at the rate of 200 to 1,000 lb. per acre, in accordance with the needs of the soil.

Plants require an abundance of lime in the soil (the best I have seen grown in Jamaica was on the site of an old lime-kiln. Tr.); and when this is deficient, it ought to be applied at the rate of 1,000 to 2,000 lb., freshly slaked, to the acre, every 4 or 5 years. The best seed should be procured. If this is attended to, it is possible to reap 34 to 60 bushels per acre. The usual distance for planting is in rows about 36 inches apart, and 7 to 9 inches between the plants. For an acre it will require about 13 to 14 litres (10 to 12 quarts) of shelled beans. Seed should be sown at a depth of three quarter to one and a quarter inch deep in compact soil, and one and a half to two in sandy soil. When the plants begin to bear pods, there is no need of further labour.

In harvesting, the roots should be left in the ground, as they are covered with numerous nodes containing nitrogen, and so help in fertilising a naturally poor soil.

Millions of bushels of peanuts are sold in Europe for oilmaking, the nut being particularly rich in fats. The oil is considered equal to olive oil, and may be used for all purposes served by the latter. The oil constitutes from 30 to 50 per cent. of the weight of the shelled beans. A bushel of first class beans which weighs 28 lb. will produce about a gallon of oil, valued at 45 cents, and 20 lb. of meal which when ground up with the husk is worth about 25 cents, and is a first class food for cattle.

Although the average yield of an acre is only 30 to 40 bushels per acre, with proper methods as much as 60 bushels may be reaped; and the "haulms" from one acre amount to from one to one and a half tons, which has a value equal to the cost of cultivation. In the U. S. A. an acre of first class peanuts, calculating the fodder at one ton to the acre, valued at $8 to $10, and 60 bushels of nuts at a value of $40 to $60, will yield an income of $48 to $70. The expenses vary from $12 to $15, including cost of seed and manure. These figures are considerably lower than those which could be obtained by the employment of scientific methods.—J. W. Graham in Jamaica Agric. Society Journal.

THE CANNON-BALL TREE.

[*See Frontispiece.*]

The Cannon-ball tree, which is now commonly known to botanists as *Couroupita guianensis*, Aubl., may be considered as one of the seven wonders of the vegetable kingdom. It is a large upright tree with rough brown bark, attaining a height of from 60 to 80 feet, with short branches which have the leaves crowded at the tips. It belongs to the Natural Order *Myrtaceæ*, or rather to the closely allied or sub-order *Lecythideæ* known as the "Monkey-pot" family. Its native habitat is Tropical South America, chiefly around Guiana. It was introduced into the Royal Botanic Gardens, Peradeniya, in 1881, and into other parts of the Eastern tropics probably about the same date. Nowhere, however, in the East does the tree appear to find so congenial a home as at Peradeniya, judging by the luxuriance of its growth and the profusion with which it flowers and produces fruit. Here the row of trees skirting the east River-drive are, at the time of writing, in full flower from within a few feet of the ground to a height of 30 feet or more. These flowered for the first time in 1900, producing in the following year a few fruits, and have blossomed regularly each year since, chiefly in the drier months of February to May. When in its full glory of flowers and fruit together, as some are at Peradeniya at the time of writing, few trees present a more striking appearance. The large and remarkable flowers have a pleasant aromatic fragrance, and form a mound at the base of the tree as they drop.

The large globular fruits are borne towards the ends of the woody racemes, and remain on the tree for upwards of a year, by which time they reach maturity and maximum size. A full-sized fruit is sometimes as much as nearly nine inches in diameter. The outside of the fruit is of a brownish-red or iron colour, with a rough bark-like surface. It consists of three distinct parts, each about a quarter of an inch in thickness, viz., the *epicarp* or rind; the *mesocarp*, which is of a fleshy nature, and the *endocarp*, which is a hard woody brittle shell. The latter encloses a mass of pulp which, at first greenish-white, turns to a bluish tint on exposure to the air. Mixed with and embedded in this are the small seeds. When the fruit is cut open the pulp emits a most disagreeable and sickly odour, which the dried shell retains for many years.

The late Sir William Hooker, Director of the Royal Botanic Gardens, Kew, in describing the Cannon-ball tree in the Botanical Magazine, remarked: "It is one of the greatest ornaments of the dense forests of Cayenne, flowering at all seasons of the year, where it is infrequently concealed from view by a mass of the "Spanish long-beard (*Tillandsia usneoides*). If the tree is rendered attractive by the beauty of its flowers, which moreover are endowed with the most delicious odour, it is no less remarkable for the size of the fruit. No more curious or interesting plant has graced our pages."

To those who are unacquainted with this tree and desire further information, the following brief description may be of interest :—

The leaves are alternate, eight to ten inches long, broadly lanceolate approaching to cuneate, and rather obscurely toothed at the margins; the petioles are about an inch long and downy.

The flowers are borne on long woody racemes from three to five or more feet in length, produced on the stem, at first immediately below the branches and in later years, extending lower and higher each year. These racemes are persistent, remaining attached to the tree, sometimes developing foliage, and repeatedly produce lateral racemes in successive years. Each bears upwards of 100 of the large and remarkable flowers, those nearest the

trunk developing first. The large round convolute flower-buds, before expansion, are pale-pink in colour and of a striking appearance; they open in the morning and fall off by the morning of the following day. The flowers are unique in form and of striking beauty, the large fleshy corolla being salmon-pink in colour and pleasantly scented. The remarkable part is the stamniferous ligule, which consists of a circular fleshy disc surrounding the upper part of the pistil. This disc is prolonged on one side into a broad strap-shaped expansion, which is folded back upon itself to form a hood, the extremity of which is covered with short, upright fleshy yellowish stamens.

The trees are completely deciduous for a short period once a year, usually in February; all do not, however, drop their leaves at the same time, as is often characteristic of tropical species, some being completely bare in August while their confreres, even when growing side by side, are in full leaf. The tree does not appear to have any commercial value, though the shell of the fruit is used in South America for domestic purposes, as the calabash. The pulp of the unripe fruit is sometimes employed in its native habitat, to afford a refreshing drink in fevers; but in the perfectly ripe state "it exceeds all that is filthy, stinking, and abominable in nature."

H. F. MACMILLAN.

PRUNING TREES.

(*Bailey's Cyclopædia*)

Fruit trees are pruned for the purpose of enabling them to produce a superior quality of fruit. They are not pruned primarily to assume any definite or preconceived shape. It is best, as a rule, to allow each variety of tree to take its own natural or normal form, only pruning it sufficiently, so far as shape is concerned, to remove any unusual or unsymmetrical growths.

1st. The fundamental conception in the pruning of fruit trees is to reduce the struggle for existence, so that the remaining parts may produce larger and finer fruits.

2nd. The result of pruning fruit trees should be to keep the tree in bearing condition, not to force it into such condition. If the tree has received proper care from the time it is planted it should come into bearing when it reaches the age of puberty. Pruning, therefore, is merely a corrective process, and keeps the tree in proper bearing condition. When trees have been much neglected, pruning may be the means of reinvigorating them and setting them into a thriftier condition. In such cases it is one of the means of renovating the tree, as tilling, fertilising, and spraying are.

3rd. Heavy pruning of the top tends to produce wood. This is because the same amount of root energy is concentrated into a smaller amount of top, thereby causing a heavier growth. This is particularly true if the pruning is done when the plant is dormant.

4th. Heavy pruning of the root tends to lessen the production of wood because the same amount of top receives a less supply of soil with its content of plant food.

5th. Trees which grow much to wood are likely to be relatively unproductive. It is an old maxim that checking growth induces fruitfulness, so long as the plant remains healthy. If the tree is thrown into redundant growth every two or three years by very heavy pruning it tends to continue to produce wood at the expense of fruit. When a tree is to be brought into bearing condition by general good treatment, the aim should be to keep it in that condition by a relatively light annual pruning. Violent pruning is allowable only when trees have been neglected and is necessary to bring them back into bearing condition, or to renew their tops.

6th. The operator should know where the fruit-buds are borne before undertaking the pruning of any fruit tree, otherwise he may destroy too many of them. If he knows the position of the fruit-buds he may prune in such manner as to thin the fruit even without the removal of much wood, and thereby to reduce the struggle for existence to a minimum. Every species of tree has its own method of fruit-bearing.

* * * *

Cacao (Cocoa or Chocolate) bears on old matured wood, and the aim with this tree is to make it grow as substantial as possible, thick trunk, three main branches, and laterals from these, arranged so as to give each branch as nearly as possible equal room, so that they may grow thick and strong. The best cacao pods are borne directly on the trunk or main branches, not on terminal twigs like oranges.

Coffee, on the other hand, bears on new wood and even with coffee there are two distinct processes of pruning. There is the pruning for what is called " short top coffee " and " long top coffee. "

Shortly the system for pruning short top coffee is to prevent crowded, twiggy growth; to have the laterals from the main trunk, equally spaced (as Nature fortunately tries to do of itself) and to have primary, secondary and tertiary branches evenly arranged also, so as not to have any of these growing too close to the main trunk, and so crowding it and preventing air circulating. An open space should be kept near the trunk. The pruning of " Long Top " coffee consists simply in calculating for a constant relay of new wood every year, as conveniently planned as may be, with the view of not interfering with the neighbouring trees, and also to facilitate picking.

Citrus trees, that is Oranges and Grapefruits, (the growth of lemons is different, but these are not grown commercially in Jamaica) bear the fruit on the terminal branches and pruning must be aimed at securing plenty of light and air circulating through the trees, with no branches or twigs crowding the inside, and to secure plenty of spreading outside growth. The sun should not be allowed to strike directly on the trunk or main branches, else the bark becomes hard and brown, hide bound as it is called, like so many pasture grown trees, i.e. instead of being greenish and succulent, it becomes hard and brown, and so the free flow of the sap is impeded. Orange and Grapefruit trees are evergreens, not deciduous trees which drop their leaves at a certain time of the year, and it is essential that their trunks should be shaded by their tops, and that their tops should present as much surface as possible to the sun.

* * * *

7th. Heading-in tends to promote fruitfulness in citrus trees, particularly in those trees that are growing over-rapidly. If the heading-in is very severe, however, it may amount to a heavy pruning; and in that case it may set the plant into wood-bearing rather than into fruit-bearing or result in a crowd of gormondizers starting. It is not to be supposed, however, that heading-in is necessarily to be advised in order to make trees bear. They may bear just as well if they are never headed-in, provided they are otherwise well pruned and cared for. Whether one shall head-in his fruit trees or not is a personal question. If the trees are growing too rapidly root pruning is often better. This is particularly necessary when trees are growing on heavy or very fertile soil and tend to overgrow. In such case, cutting off the strongest leaders and inducing laterals is a good policy.

8th. Pruning fruit trees usually resolves itself into a thorough and systematic thinning out of the weak, imperfect, and interfering branches. Thereby the energy of the plant is saved, and is deflected to those parts that

are capable of bearing a useful product; the sun and air are admitted; the tree becomes manageable for spraying and for picking; all the fruits have an opportunity to develop. How much or how little to thin is wholly a local question. In humid climates, much thinning may be necessary. In dry, hot climate as on the plains—but little thinning is allowable, else the branches may sun-scald.

The foregoing are among the practical purposes to be served in pruning, and it will be seen that there are various ends to attain; therefore, have an ideal towards which to work, and always have an object in view when severing branches, shoots or spars from any portion of the tree. Never by any chance lose an opportunity of picking up any points from your neighbour, but don't attempt to follow everybody's advice. — Jamaica Agric. Soc. Journal.

FERTILITY OF SOILS.

SOLUTION OF PLANT FOOD.

Dr. C. F. Juritz.

I have said that unless the plant food constituents in the soils decompose they cannot be absorbed by the plants. The main reason of this is that until they decompose they do not become soluble, and that they should become soluble is essential, seeing that plants take up their food from solution. But how does the plant food get dissolved in the soil? First of all by the acids which the root hairs of the plants secrete. The roots of plants, as far as can be ascertained, secrete carbonic acid, while many also secrete oxalic and citric acids. These act on the fine soil particles, and dissolve them in a manner that in most cases pure water could not do, and so this plant food is rendered capable of absorption into the plant itself. But there is another way in which this solution is obtained, and that is quite independent of root action on the part of the plant. I referred at an earlier stage to the three forms of water in the soil: first, there is the free water that drains away or runs off quite easily and rapidly after flooding by rain or irrigation; next there is the capillary water that does not run away, but moves about slowly, and only under the stronger force of capillary attraction, and is not lost to the soil unless by evaporation from the surface, or when the plant root absorbs it; last of all there is the film water, which, by the immense power of surface tension acting on an almost infinitely thin film of water, is so tenaciously held by the tiny soil particles, with a pressure, it is said equal to 10,000 times that of the atmosphere, or 150,000 lb. per square inch, that only the application of heat can break the bond. Now under this great pressure chemical reactions may occur which are quite impossible under ordinary conditions, and so too this film water may dissolve out of those soil particles elements of plant food which would not ordinarily be dissolved out of minerals by water. These are the means by which the plant food in the soil enters into that liquid state in which alone the plant can absorb it. Once dissolved in the film water, the plant food may, with comparative ease, be passed on to the capillary water, and be thereby transported to other parts of the soil for the plants to feed on. The roots are always, as it were, sucking up this capillary water thus charged with plant food, and as soon as the soil in the immediate vicinity of the rootlets is dried by this suction, capillary attraction causes the water from adjacent parts of the soil to creep along to supply its place, so that there may be said to be a continuous current of capillary water in the direction of each root hair.

As the dissolving power of the film water varies greatly according to the minerals that it acts on ; and as the root hairs of different plants secrete different acids, or the same acids in different strengths, you will understand how impossible it is for the soil chemist, with one standard method of soil extraction to treat the soil in his laboratory precisely in the manner that plants act on it : all that he can do is to approximate as nearly as possible to the field conditions without ever hoping to imitate them exactly.

But in discussing the actual process of plant feeding, I have hitherto been dealing only with the mineral constituents of plant food ; nitrogen is not included among these, but is usually contained in the soil in two other forms, namely, as (1) organic nitrogen, in the remains of dead leaves and other parts of plants, and (2) as atmospheric nitrogen, in the air that circulates through the pore spaces in the soil. The organic nitrogen is just as incapable as the mineral silicates of becoming dissolved in the soil water, and before it can enter into the plant it has to be transformed into soluble nitrates. This transformation is effected by certain kinds of bacteria or micro-organisms in the soil. As for the atmospheric nitrogen it can be taken up only by leguminous plants, or plants which are provided with nodules or swellings on the roots, and these nodules swarm with other bacteria. In both cases, whether it be the soil bacteria that fix the organic nitrogen or the plant bacteria that utilise the atmospheric nitrogen, bacteria constitute the means of rendering nitrogen available to the plant, and the first requisite for a successful issue of course is the presence in the soil of those bacteria. In fertile soils they are present in enormous numbers, but in other soils they may be practically absent, and such soils have to be inoculated with the needed bacteria before any nitrogen fixation can go on. Next, the soil must have a free air circulation, not alone that the nitrogen which leguminous crops need may be supplied to them, but also because the bacteria cannot live unless certain conditions are fulfilled, and one of these conditions is a sufficiency of air in the soil. If the air supply of the soil is so dense that air cannot circulate in it the bacteria may be said to be drowned in one case and suffocated in the other. They can as little exist in a soil that lacks moisture, as in one that has all its air spaces filled with water, and so the happy medium must be observed, and in order that the best results may be obtained, the soil may have what is called its optimum of water. There are therefore, as you see, many factors that between them regulate that optimum.

CONDITIONS AFFECTING SOIL FERTILITY.

Do not imagine that an unproductive soil always means deficiency in plant food. It may mean that and it may not. It may mean that there is abundance of plant food material, but not just in that condition wherein plants can take it in ; it may mean that there is not only plant food material, but even plant food itself in an available condition, but that lack of aeration, brought about either by excessive density of the soil or by water-logging, is stifling the plant's root action. Unproductiveness in soils is so often the result of cultural errors that it is unwise to seize upon lack of fertility as the fundamental cause, and yet that is exactly what most people do. It is true that there are many soils in this country that are wanting in fertility, but I have quoted to you several cases of chemically good soils in which mismanagement of water supply or imperfect physical manipulation has caused the ills that have been laid at the door of the soil's chemical qualifications. We cannot deal with those ills by mere random guess-work ; they require study, especially in a relatively young country, and as our conditions generally are so different from those of the older countries, we need fuller study of our many productive soil types, in order that they may serve as standards of comparison when we are faced with problems of unproductive soils or have to deal with cases of actual or supposed infertility.—Agri. Journal of the Union of S. Africa.

DECOMPOSITION OF MINERALS: SOIL CHEMISTRY.

It is not enough, however, that the mineral constituents which go to form plant food should be merely mechanically disintegrated, they also need to be chemically decomposed. By this I mean that the rocks of which soils are made must not only become a fine powder before plants can make use of what they contain, but the very substances of which those rocks consist must undergo an internal change. There are, as you see, two separate branches of science involved here; soil physics is concerned in the investigation of the mechanical condition of the soil, and soil chemistry in that of its chemical condition; and the one science cannot say to the other, "I have no need of thee." In the Vine Diseases Commission's Report, issued in 1881, the results of analyses of a number of granite soils from Constantia, performed by Professor Hahn, were tabulated. In many cases it was found that the vines were poor and sickly, having evidently been badly nourished, although the granite rock, from which the soil whereon they stood had been derived, to all appearances contained ample quantities of lime, potash, and phosphoric oxide. On other soils, derived from that identical granite, the vineyards were healthy and thriving. In both cases there were ample supplies of the materials of plant food in the soil, but in the one case the granite had been merely disintegrated, and in the other it had been thoroughly decomposed as well. That means to say that in the former case the plant-food materials were there, but not in the condition available for the plants. In the latter case, not only were the plant-food materials there, but they had been converted into actual plant food, by thorough decomposition of the granite. The result was that the soil on which the vineyards flourished contained eight times as much available lime, six times as much available potash, and twelve times as much available phosphoric oxide as the average of the remaining soils. This one soil was a particularly good granite alluvium. In another of these Constantia soils there was no available lime whatever, simply because the felspar which would have supplied it had not been decomposed.

From this you observe that it is not enough for a soil merely to contain lime and potash; these may be there in so coarse a condition that the plant roots can do nothing with them. And even if they are in the soil as a more or less fine powder, they may be present only as silicates, and in that state they cannot get dissolved, and so the plants fail to absorb them, because it is necessary for plant food to enter into solution before the plants can take it up.

It is therefore very essential to the fertility of a soil that it should contain its plant-food materials in such a form that they may be available to the plant. If they are not available they might just as well not be there at all, and so, in chemical soil analysis, the availability or non-availability of the plant-food materials present is an all important matter for consideration. There has often been an outcry against soil analysis by people who did not know what they were tilting at. Methods of analysis which involve fusion or disclosing of the silicates in the soil may be interesting to the geologist, but for the practical agriculturist they have little value. It is as useless to tell a farmer that the total percentage of potash, lime, or magnesia in his soil is so and so much, as it would be to make him a free gift of all the gold that lies in the wrecked *Titanic*, four miles below the surface of the Atlantic Ocean. Both are useless because non-available. But, apart from this, the availability of plant food in soils is tested by different methods. Some investigators take strong boiling acids, and subject the soils to their action for a few minutes only. Others take cold acids and leave them on the soils for days. Others again use almost the weakest acids they can find, and use them in the cold. Naturally the results that you get from one and the same soil by such vastly different

methods of analysis must differ very much from each other. These different methods are being used in different parts of this Union, and so farmers have come to me in perplexity with seemingly contradictory figures, and have asked me how they can be reconciled. Professor Hilgard, of California, one of the most renowned soil investigators in the world, in his treatise on "Soils," expressed his deep regret that in various parts of the world methods of soil analysis were being used which were so incommensurable that it was quite impossible ever to compare agriculturally the soils of the various countries as to their chemical nature, and, writing to me on the subject about three years ago (7th May, 1910), he said :—

"I am greatly pleased that you have adopted my method of soil extraction for your work. I believe it to be the one most likely to find general acceptance, as having a natural element not subject to arbitrary personal bias. I have given the method a long trial, and find that results can be successfully interpreted, but I regret more and more the amount of energy wasted upon arbitrarily fixed methods, which are unlikely ever to receive universal assent."

At the International Agrogeological Congress at Budapesth in April, 1909, a report by the same eminent authority on "The Unification of Chemical Soil Analysis" was read, in which he pleaded earnestly for uniformity the world over ; with us in South Africa diversity is excused on the plea that independence of operators gives the best results.—Dr. Chas. F. Juritsz in South African Agric. Journal.

THE BANANA AS A FOOD.

SIR JAMES CRICHTON-BROWNE.

Dr. G. Arbour Stephens' suggestion that bananas may be a factor in the increased prevalence of appendicitis seems to me to be utterly without scientific foundation, and should not have been lightly offered. As he is himself evidently aware it is a very serious step to take, to throw doubt on the harmlessness of a popular food, and that step should not have been taken in the case of the banana without better warrant than he is able to show. It is not only that an important branch of the trade in which some of our colonies and dependencies are largely interested may be injured, at least temporarily, by the suspicion raised, but that multitudes of people incapable of judging of its justice may be scared by it, much to their own detriment, into foregoing the use of an agreeable and wholesome article of diet. Appendicitis is a word to conjure with in these days, and the ignorant, the foolish, and the faddists in their fear of it are not unlikely to swallow Dr. Stephens' allegation and to cease to swallow the banana. The discerning, however, and those who look into the so-called proofs advanced will, I think, conclude that notwithstanding Dr. Stephens' indictment, the banana remains without a stain on its character, and may be enjoyed without a vestige of trepidation.

Dr. Stephens' main agrument, if agrument it can be called, is that there has been in the last ten or twelve years an enormous increase in the prevalence of appendicitis in this country, and that in the same period there has been an enormous increase in the consumption of bananas by our people, and, *ergo*, the bananas are responsible for the appendicitis. But during the period in which the increase of appendicitis has taken place — and it has not perhaps really increased as enormously as Dr. Stephens' would have us believe—there has been an enormous increase in the consumption of meat, and it is to the increased consumption of meat that Dr. Owen Williams has ascribed the increase of appendicitis. During the same period there has been an enormous increase in the consumption of tomatoes, and why should not the tomato be responsible for the appendicitis ? During the same period there has been the

enormous increase in the number of motor vehicles and why should they not be the explanation of the prevalence of appendicitis, for trauma is one of its acknowledged exciting causes and the comparative exemption of infants from it has been ascribed to the fact that they spend most of their time lying down, and are free from jars. If a mere concomitant increase in any dietic custom of habit of life is to be accepted as an explanation of the increased prevalence of appendicitis, then a hundred such could be suggested, with a *reductio ad absurdum* of the banana theory.

Dr. Stephens supports his banana theory by contentions which are, I think, exceedingly questionable. He says one does not find much appendicitis below the poverty line simply because the people in that zone have no pennies to spare on such a luxury as a banana. Now, I do not know any accurate statistics showing the distribution of appendicitis in different social grades, but of this I am quite sure, that there is now no poverty line circumscribing the sale of bananas. They are within the reach of the poorest, and are carried by hucksters' barrows into the most poverty stricken districts in town and country and sold largely at three or four a penny, because it is recognised that they are not only a luxury but a food. I believe I shall be correct in saying that the banana has become vulgarised, and is now much more largely consumed by the humble than by the affluent classes, so that if appendicitis is more frequent amongst the latter than amongst the former bananas can be in no way connected with their greater liability to it.

In tracing out his parallelism between the prevalence of appendicitis and the consumption of bananas Dr. Stephens has curiously omitted to say anything of the notable fact that at all ages males suffer from appendicitis in much larger numbers than females, probably in the proportion of 5 to 3, but males at all ages, after childhood, are less addicted to bananas than females, who are attracted by saccharine foods, which to males, and especially to smokers, have no particular charm.

Errors in diet undoubtedly conduce to appendicitis, but special culpability in this connection cannot be attached to any particular articles of diet, except those which contain seeds or pips, or are hard and indigestible. The banana is really the blandest and most digestible of fruit-foods, and, as partaken of in this country, is fully disposed of long before it reaches the caecum and region of the appendix. It is made up of 74 per cent. of water, 22·7 per cent. of carbo-hydrate, 2·2 per cent. of proteid and extract, ·9 per cent. of mineral matter, and ·2 per cent. of cellulose. It is really its easy digestibility as much as its delicate flavour that has largely contributed to its popularity. The most delicate stomach tolerates it, and no inconvenience attends its passage through the alimentary canal.

The immediate cause of appendicitis is always microbic infection, but Dr. Stephens' adduces no scrap of evidence that the banana induces by its presence in the bowel the conditions which render dangerous microbic contents that are normally innocuous. The statement that bananas have an irritating effect on the intestine and are therefore conducive to appendicitis is lacking of proof. It is buttressed by the statement that they are frequently given to children for aperient purposes. I do not know that this is so, but, if it is, then it must be borne in mind that numerous other inappropriate articles of food, even whelks and cockles, are given for the same purpose. Stewed apples and prunes are constantly thus employed, and they have not yet been catalogued as causes of appendicitis.

Appendicitis is not a thing of yesterday. I recollect seeing many cases of it passing under the name of typhlitis in by-gone years, when there were no bananas in this country beyond a few clusters of the banana *Cavendishii*, grown in the hot-houses of the rich. It is seen to-day, although comparatively rarely, in infants who have never tasted a banana, not even for

aperient purposes. It occurs in grown persons who have never touched bananas. Above all it is practically unknown in those races that feed most largely on bananas. The negroes in the Northern and Southern States of America are almost wholly exempt from appendicitis, and they consume bananas in prodigious quantities, while the white inhabitants of these States who partake of bananas sparingly frequently suffer from appendicitis. Dr. Stephens attempts to account for this damning fact by suggesting that the high climatic temperature is protective to the Negroes living in banana-growing areas; but the protection is not confined to these areas, for it is noted in Negroes living in temperate regions, climatically akin to our own into which bananas are imported. The inhabitants of the Central States of South America, who consume imported bananas freely, are little subject to appendicitis; the rule indeed would seem to be that the prevalence of appendicitis is in the inverse ratio of the consumption of bananas.

I need not waste time in controverting Dr. Stephens' speculations about the different varieties of the banana and his supposition that it is the virulent ones that are exported for our benefit. Dr. Stephens seems to have acquainted himself very imperfectly with the forty different species of the Musadae.

Dr. Stephens' dietetic notions seem to be of an unique description. With remarkable insight into cosmic design, he tells us that bananas "are intended for food for Niggers," and he deplores the fact that "the highly and hyper-civilised," whatever that may mean, people of these British Isles prefer to live on food brought from all parts of the world, instead of "tilling their own little cabbage patches at home." "Cosmopolitanism," he says, somewhat ambiguously, "has its drawbacks, but if they have to be paid for by a disturbed health-rate, the sooner the better we consider the position." "Before the importation of all these foreign food stuffs," he goes on, "the people of these islands ate what they produced." He seems inclined to carry us back to a very restricted regimen, "broth and porridge" in Scotland, "cawl and succan" in Wales. According to him all people that on earth do dwell should eat only the produce of the soil on which they find themselves. We shall have to give up tea, coffee, cocoa, potatoes, oranges, a thousand luxuries, and must look even on foreign flour with suspicion. It would be perhaps useless to remind Dr. Stephens that foreign food stuffs are now the very life-blood of the country, and that just in proportion as they have been brought to us has the death-rate fallen. The important point is that coming from a quarter in which such singular views on dietetic questions are entertained, the malediction of the banana need not count for much.

The banana is a clean, wholesome, nourishing and fragrant addition to our food supply—*sans peur et sans reproche*—a boon and a blessing to our people.—West India Committee Circular.

RESEARCH, EXPERIMENT AND DEMONSTRATION.

The Experiment Station Record (U. S. A. Department of Agriculture) for December last contains an instructive editorial dealing with these subjects. In a complex subject like Agriculture the difficulty of fixing exact lines of demonstration between these three branches of work is greatly felt. At present the terms are used loosely and in a way to confuse most people; and for this reason we should like to reproduce what to our mind is a clear exposition of their meaning and scope.

One of the most satisfactory definitions of research is "diligent, protracted investigation, especially for the purpose of adding to human

knowledge . . . . . Specially in science, a systematic investigation of some phenomenon or series of phenomena by the experimental method, to discover facts or to co-ordinate them as laws." It is, therefore, scientific, it is systematic, it is extended inquiry, it employs the experimental methods, and it proceeds by the discovery of facts, which alone or coordinated contribute to understanding or permit laws or principles to be developed.

The term investigation is largely used synonymously with research. To investigate is "to inquire into systematically; ascertain by careful research." The same general method and character of inquiry are implied in both "systematic examination of some scientific question, whether by experiment or mathematical treatment." If there be a difference, it is one of degree rather than of kind. Both aim at the advancement of definite knowledge through science. It is therefore the method and essentials of science that we are concerned with in reaching conceptions of research and investigation in any field.

SCIENCE.

First of all science is a matter of classification, a bringing together of facts in a system of relations. The function of science is to teach us the relations of facts to each other and their consequences. Science does not teach us the true nature of things—what heat is, what electricity is—it can only give a crude idea of these, but it can teach us the true relation of these things, their attributes, and their consequences. A recently-published translation of *The Foundation of Science*, by H. Poincare, a French mathematician, is remarkably illuminating in defining the nature of science and the method by which it is developed; and while it deals largely with the philosophy of pure mathematical and physical science, it will be found helpful in any study of this subject.

Science, whether for itself or as applied to any particular class of phenomena, is developed through research. In agriculture we deal largely with natural phenomena of endless variety; while the object sought is ultimately practical knowledge or information, the standards and the methods must conform to those of science in general. The method of science is that of observation and experiment, guided and supported by reason and generalization. Observation and experiment teach facts; and in all science investigation consists in passing up from the fact to the law, and in discovering the facts capable of leading to a law or conclusion. Facts and laws are not artificial or accidental, and are not made by the scientist. Man's only originality in connection with them is their discovery.

Observation and experiment are therefore fundamental to progress in natural science. Because of this and because "it is better not to see than to see wrongly," these observations should be made with care and skill and so planned as to furnish a clear, decisive result which can be given a safe interpretation. This is the great secret of success in agricultural investigation. The subject and the conditions are usually complex, and the results are very likely to be complex, embodying a variety of factors and dependent upon many limiting conditions. For this reason the conditions of the experiment must be as simple as possible, and limiting factors checked or controlled to the utmost degree. In this way the number of variants will be reduced to a point where safe deductions can be made as to their several effects. The attempt to make an experiment answer too many questions, with a result that is fatal to the whole undertaking, is perhaps one of the most common errors of the over-ambitious worker.

(*To be continued*)

MARKET RATES FOR TROPICAL PRODUCTS.

(From Lewis & Peat's Latest Monthly Prices Current.

	QUALITY.	QUOTATIONS.
ALOES, Socotrine cwt.	Fair to fine	40/ a 50/
Zanzibar & Hepatic ,,	Common to good	40/ a 70/
ARROWROOT (Natal) lb.	Fair to fine	6d a 7d
BEES' WAX cwt.		
Zanzibar Yellow ,,	Slightly drossy to fair	£77.6 a £8 2/6
East Indian, bleached ,,	Fair to good	£8 10/a £8 15/
,, unbleached ,,	Dark to good genuine	£6 10/ a £7
Madagascar ,,	Dark to good palish	£7 17/6a £ 8 5/
CAMPHOR, Japan lb.	Refined	1/4½ a 1/6¼
China cwt.	Fair average quality	155/
CARDAMOMS, Tuticorin	Good to fine bold	6/ a 6/3
per lb	Middling lean	5.2 a 5/7
Malabar, Tellicherry ,,	Good to fine bold	6/ a 6/3
Calicut ,,	Brownish	3/11 a 5/8
Mangalore ,,	Med Brown to good bold	5/3 a 6/6
Ceylon, Mysore ,,	Small fair to fine plump	4.3 a 6/1
Malabar ,,	Fair to good	3/6 a 3/8
Seeds, E. I. & Ceylon ,,	Fair to good	4/7 a 4/9
Ceylon "Long Wild" ,,	Shelly to good	2/3 a 3/6
CASTOR OIL, Calcutta ,,	Good 2nds	3¾d
CHILLIES, Zanzibar cwt.	Dull to fine bright	45/ a 50/
Japan ,,	Fair bright small	50/
CINCHONA BARK.—lb.	Crown, Renewed	3⅜ d a 7 d
Ceylon	Org. Stem	2d a 6d
	Red Org. Stem	1⅜ d a 4¼d
	Renewed	3d a 5¼d
	Root	1⅞d a 4d
CINNAMON, Ceylon 1sts.	Good to fine quill	1/3 a 1/7
per lb. 2nds.	,, ,,	1/2 a 1/6
3rds.	,, ,,	1/1 a 1/5
4ths.	,, ,,	1/ a 1/3
Chips.	Fair to fine bold	2d a 4d
CLOVES, Penang lb.	Dull to fine bright pkd.	1/1 a 1/3
Amboyna ,,	Dull to fine	10d a 10½d
Zanzibar ,,	Fair and fine bright	5⅞d a 6½d
Madagascar ,,	Fair	7d
Stems ,,	Fair	3d
COFFEE		
Ceylon Plantation cwt.	Medium to bold	Nominal
Native	Good ordinary	50/a 55/
Liberian ,,	Fair to bold	63/a 80/
COCOA, Ceylon Plant. ,,	Special Marks	81/ a 88/6
	Red to good	73/ a 80/6
Native Estate ,,	Ordinary to red	42/ a 68/
Java and Celebes ,,	Small to good red	30s a 93s
COLOMBO ROOT ,,	Middling to good	12/ 6a 21/
CROTON SEEDS, sifted,,	Dull to fair	40/ a 45/
CUBEBS ,, ,,	Ord. stalky to good	130/ a 150/
GINGER, Bengal, rough ,,	Fair	19/
Calicut, Cut A ,,	Medium to fine bold	60/ a 75/
B & C ,,	Small and medium	36/ a 60/
Cochin, Rough ,,	Common to fine bold	22/6 a 30/
	Small and D's	20/
Japan ,,	Unsplit	23/
GUM AMMONIACUM ,,	Ord. Blocky to fair clean	40/s a 72s 6d
ANIMI, Zanzibar	Pale and amber, str. srts	£14 10/a £16 10/
,,	,, ,, little red	£11 a £12
,,	Bean and Pea size ditto	70/ a £11
,,	Fair to good red sorts	£8 10/ a £10 10/
,,	Med. and bold glassy sorts	£5 a £7
Madagascar ,,	Fair to good palish	£4 a £8
,,	,, red	£4 a £7
ARABIC, E. I. & Aden ,,	Ordinary to good pale	26/ a 30/
Turkey sorts ,,		32/ a 55/
Ghatti ,,	Sorts to fine pale	18/6 a 30/ nom.
Kurrachee ,,	Reddish to good pale	25 a 30s nom.
Madras ,,	Dark to fine pale	22/6 a 29/6 nom
ASSAFŒTIDA ,,	Clean fr. to gd. almonds	£ 6a £6 10/
	com. stony to good block	40s a £5
KINO lb.	Fair to fine bright	6d a 1/5
MYRRH, Aden sorts cwt.	Middling to good	57/6 a 67/6
Somali ,,	,, ,,	52s 6d a 57s 6d
OLIBANUM, drop ,,	Good to fine white	45s a 50s
,,	Middling to fair	35s a 40s
pickings ,,	Low to good pale	15/ a 27/6
siftings ,,	Slightly foul to fine	18 s a 27s
INDIA RUBBER lb.	Fine Para smoked & sheets	2/6½
Ceylon, Straits, ,,	Crepe ordinary to fine	2/6
Malay Straits, etc. ,,	Fine Block	2/5½
Assam ,,	Scrap fair to fine	1/11 a 2/1
,,	Plantation	2/
Rangoon ,,	Fair 11 to ord. red No. 1.	1/6 a 1/9
	,, ,, ,,	1/3 a 1/6

	QUALITY.	QUOTATIONS.
INDIARUBBER lb.		
Borneo ,,	Common to good	9d a 1/4
Java ,,	Good to fine red	1/4 a 1/8
Penang ,,	Low white to prime red	9 d a 1/6
Mozambique ,,	Fair to fine red ball	1/10 a 2/4
,,	Sausage, fair to good	1/9 a 2/3
Nyassaland ,,	Fair to fine ball	1/9 a 2/1
Madagascar ,,	Fr. to fine pinky & white	1/6 a 1/8
,,	Majunga & blk coated	1/ a 1/3
,,	Niggers, low to good	6d a 1/6
New Guinea ,,	Ordinary to fine ball	1/4 a 1/7
INDIGO, E.I. Bengal ,,	Shipping mid to gd. violet	3s 3d a 3s 8d
,,	Consuming mid. to gd.	2s 9d a 3s 2d
,,	Ordinary to middling	2s 4d a 2s 9d
,,	Mid. to good Kurpah	1s 11d a 2s 5d
,,	Low to ordinary	1s 6d a 1s 9d
,,	Mid. to fine Madras	1/11 a 2/9
MACE, Bombay & Penang	Pale reddish to fine	2/4 a 2/6
per lb.	Ordinary to fair	2/ a 2/2
Java	,, ,, good pale	2/ 1a 2/4
Bombay	Wild	1/
NUTMEGS,— lb.		
Singapore & Penang ,,	64's to 57 s	9½d a 10½d
	80's	7½d
	110's	6½d
NUTS, ARECA cwt.	Ordinary to fair fresh	17/6 a 20/
NUX VOMICA, Cochin	Ordinary to good	11/ a 13/ nom.
per cwt. Bengal	,, ,,	10/6
Madras	,, ,,	10/6 a 11
OIL OF ANISEED lb.	Fair merchantable	5/11
CASSIA ,,	According to analysis	2/11 a 33/
LEMONGRASS oz.	Good flavour & colour	2½d
NUTMEG ,,	Dingy to white	1½d a 1⅞d
CINNAMON ,,	Ordinary to fair sweet	3½d a 1s 5d
CITRONELLE lb.	Bright & good flavour	1/6½
ORCHELLA WEED—cwt		
Ceylon ,,	Fair	15/
Madagascar ,,	Fair	15/
Zanzibar ,,	Fair	15/
PEPPER—(Black) lb.		
Alleppy & Tellicherry	Fair	5⅜d
Ceylon ,, ,,	Fair to fine bold heavy	5 a 5⅜d
Singapore ...	Fair	5d
Acheen & W. C. Penang	Dull to fine	5d a 5½d
(White) Singapore ,,	Fair to fine	8½d a8¾d
Siam ,,	Fair	8⅜d
Penang ,,	Fair	7⅞d
Muntok ,,	Fair	9d
RHUBARB, Shenzi ,,	Ordinary to good	2/ a 4/
Canton ,,	Ordinary to good	1/10 a 3/6
High Dried,,	Fair to fine flat	11/a 1/1
	Dark to fair round	9 d a 11d
SAGO, PEARL, large--cwt	Fair to fine	18/
medium ...	,, ,,	17/
small ...	,, ,,	13/ a 14/
Flour ...	Good pinky to white	10 a 11/
SEEDLAC cwt.	Ordinary to gd. soluble	65/ a 75/
SENNA, Tinnevelly lb.	Good to fine bold green	5d a 8½d
	Fair greenish	3d a 4½d
	Common specky & small	1¼ d a 2½d
SHELLS, M. o' PEARL—		
Egyptian cwt.	Small to bold	82/6 a £6
Bombay ,,	,, ,,	60/ a £6 nom
Mergui ,,	,, Chicken to bold	£9 15 a £15
Manilla ,,	Fair to good	£7 10 a £1+ 10/
Banda ,,	Sorts	60/ a 65
Green Snail ,,	Small to large	50/ a 82/6
Japan Ear ,,	Trimmed selected small to bold	30/ a £7
TAMARINDS, Calcutta...	Mid to fine bl'k not stony	14/ a 15/
per cwt. Madras	Inferior to good	6/ a 10/
TORTOISESHELL—		
Zanzibar, & Bombay lb.	Small to bold	14/6 a 29/
	Pickings	8/ a 19/
TURMERIC, Bengal cwt.	Fair	10/6
Madras ,,	Finger fair to fine bold	14/ a 16 6
Do. ,,	Bulbs ,, ,, [bright	12/ a 13/
Cochin ,,	Finger fair	13/ nom
	Bulbs ,,	12/
VANILLOES— lb.		
Mauritius ... 1sts.	Gd. crystallized 3½a 8½a in.	10/a 15/
Madagascar ... 2nds.	Foxy & reddish 3½a ,,	9/6 a 12/
Seychelles ... 3rds.	Lean and inferior	9/ a 10/
VERMILLION ... lbs.	Fine, pure, bright	2/8
WAX, Japan squares cwt.	Good white hard	54/

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Photo by H. F. Macmillan

AVENUE OF PALMYRA PALM, *Borassus flabellifer*,
in Royal Botanic Gardens, Peradeniya

(*See page 433*)